Series 1936, No. 15 Issued May 1942

Soil Survey

Roane County Tennessee

By
M. E. SWANN, in Charge
WALLACE ROBERTS, E. H. HUBBARD
and H. C. PORTER
Tennessee Agricultural Experiment Station

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
In cooperation with the
Tennessee Agricultural Experiment Station
and the Tennessee Valley Authority

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TENNESSEE AGRICULTURAL EXPERIMENT STATION

C. A. MOOERS, *Director*

and the

TENNESSEE VALLEY AUTHORITY

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SOIL SURVEY OF ROANE COUNTY, TENNESSEE

By M. E. SWANN, in Charge, WALLACE ROBERTS, E. H. HUBBARD, and H. C. PORTER, Tennessee Agricultural Experiment Station

Area inspected by J. W. MOON, Inspector, District 2, Division of Soil Survey,[1] Bureau of Plant Industry, United States Department of Agriculture

United States Department of Agriculture in cooperation with the Tennessee Agricultural Experiment Station and the Tennessee Valley Authority

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[1] The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

COUNTY SURVEYED

Roane County is in the central part of eastern Tennessee (fig. 1). Kingston, the county seat, is 35 miles west of Knoxville, 75 miles northeast of Chattanooga, and 130 miles east of Nashville. The county is roughly rectangular in shape and extends in a northeast-southwest direction. It is approximately 25 miles long and 15 miles wide. The total area is 380 square miles, or 243,200 acres.

The county forms a part of two important physiographic units, the Cumberland Plateau section and the great valley of east Tennessee. About nine-tenths of the county is in the great valley and about one-tenth on the Cumberland Plateau. The conspicuous Cumberland escarpment, which is the southeastern boundary of the Cumberland Plateau, lies just inside of and parallel to the northwestern boundary of the county.

The great valley section is characterized by a series of alternating ridges and valleys (pl. 1, *A*), which all extend in a southwest-northeast direction, parallel to the Cumberland escarpment. In the northeastern part, six fairly well defined ridges in the valley section rise from 300 to 400 feet above the adjoining valley floors. Figure 2, a relief map of the county, shows the main ridges and valleys.

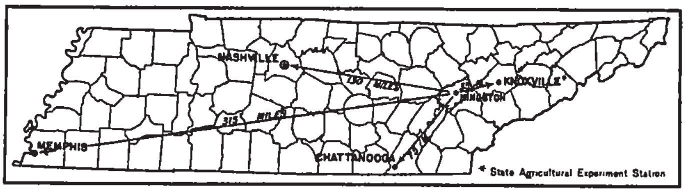


FIGURE 1.—Sketch map showing location of Roane County, Tenn.

The entire county is underlain by sedimentary rocks that were deposited during the Paleozoic era (*13*, *14*).[2] The rock strata in the Cumberland Plateau have been subjected to practically no folding or faulting; hence, they are nearly horizontal. In the valley, however, practically all of the strata have been subjected to folding and faulting; hence, practically all dip considerably. In the great valley, the rocks that underlie the ridge tops are more resistant to weathering than the rocks underlying the interridge valleys.

Practically all of the ridges in the great valley section are underlain by either cherty dolomite or interbedded shale and sandstone. Ridges underlain by the cherty dolomite, as are Walker, Copper, Chestnut, and Black Oak Ridges (fig. 2), generally have broad well-rounded or rolling crests; whereas those underlain by interbedded sandstone and shale, as are Paint Rock, Dug, Hurricane, River, and Pine Ridges, have sharp or pointed crests. The valleys between the ridges are underlain by high-grade limestones, argillaceous limestone, or shale, which all weather comparatively easily.

Sinkholes characterize the landscape wherever the underlying rock is limestone or dolomite. They range in size from a few square rods to a few acres. Some hold water most of the year and furnish water

[2] Italic numbers in parentheses refer to Literature Cited, p. 125.

for livestock (pl. 1, *B*). Others hold water for short periods, and still others retain no water.

The part of the Cumberland Plateau within the county is from 700 to 800 feet higher than the great valley and is, for the most part, deeply dissected. The valleys are deep, V-shaped, and have steep walls. The land is everywhere very steep—too steep for any agricultural pursuits—except on about 2,600 acres west, north, and northeast of Rockwood, where the surface is undulating and rolling.

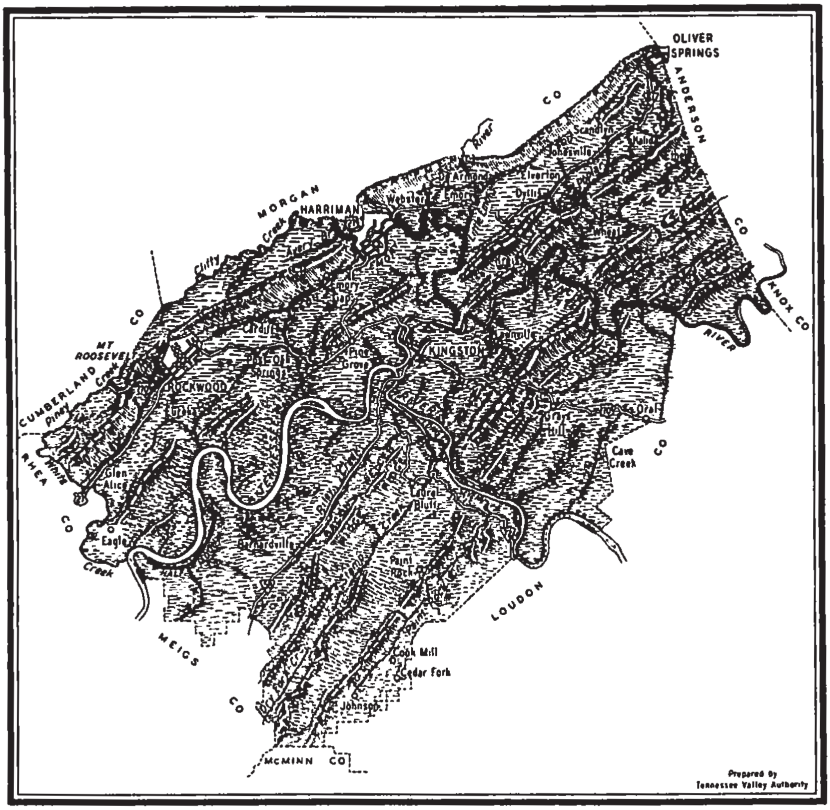


FIGURE 2.—Relief map of Roane County, Tenn.

Drainage is well developed. All the streams eventually reach the Tennessee River, the largest river in the county. The Emory River empties into the Clinch River and the Clinch River into the Tennessee River in the central part of the county. The general slope is toward the southwest, and all the rivers flow in that general direction. A well-defined dendritic drainage pattern has developed in the Cumberland Plateau, and a fairly well defined trellis pattern has developed in the great valley. Creeks and small streams in the great valley flow parallel to the ridges except where they cut sharply to the right or left and cross the ridges through narrow gaps. Most of the creeks flow in a southwesterly direction, but a few small streams flow northeastward for short distances. The

river courses are more or less independent of the small ridges, but in a general way they parallel the larger ridges, cutting across them here and there at nearly right angles. Stream bottoms and terraces are comparatively narrow, even along the rivers. In the areas underlain by limestone and dolomite, much of the drainage water enters underground channels through sinkholes (pl. 1, *B*). Because of these numerous sinkholes and underground streams, the local surface drainage pattern is, in many places, disconnected and irregular.

The present relief is the result of a continuous attack by the forces of weathering on the sedimentary rocks, through thousands and probably millions of years. On the insoluble rocks—sandstone and shales—weathering has been chiefly mechanical, that is, geologic erosion by running water; but on the soluble rocks—limestones—weathering has been not only mechanical but also largely chemical, that is, dissolution by percolating waters. In the great valley section the geologic formations consisting of the rocks most resistant to weathering have given rise to ridges, and the formations consisting of rocks least resistant to weathering have become the valleys. The ridges and valleys follow the outcrops of the slowly weathering and the rapidly weathering rocks, respectively, the directions of which are the same as the strikes of the rocks.

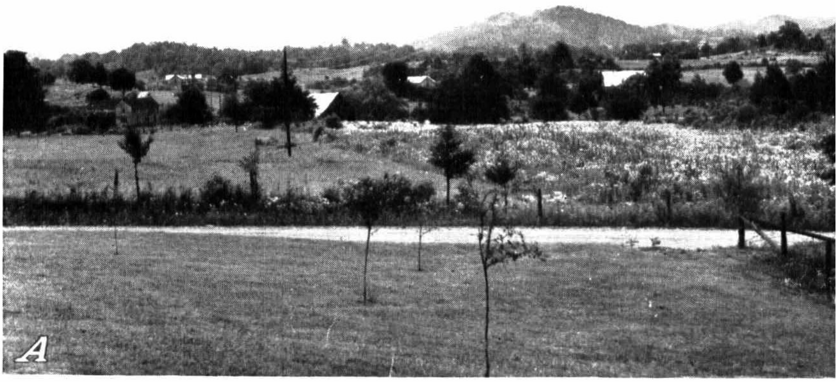
The highest point in the county is about 2,000 feet above sea level, the altitude of Mount Roosevelt, which is on the Cumberland Plateau in the western part of the county. Most of the land surface in the Cumberland Plateau ranges in elevation from 1,200 to 1,800 feet. The lowest point is where the Tennessee River leaves the county—about 700 feet above sea level. In the great valley most of the valley floors lie from 700 to 900 feet above sea level, and most of the ridge tops have altitudes ranging from 1,100 to 1,300 feet (*13*, *14*). Some elevations in the county are as follows: Kingston, 751 feet; Harriman, 783 feet; Rockwood, 885 feet; and the railroad crossing over White Creek, 802 feet.[3]

Water is plentiful, and springs are numerous in all parts of the county, particularly in the great valley section. Streams and springs provide water for livestock in practically all sections; and springs, wells, and cisterns provide water for human consumption. Considerable fishing, for sport and recreation, is done in the numerous streams. There are no natural lakes.

Before white men came to this county the entire area was in forest, chiefly of deciduous trees. Oaks were probably the dominant trees, but many chestnut trees also were present. Other species were yellow poplar, elm, maple, gum, hickory, hackberry, black walnut, and dogwood. Pine trees apparently were numerous in some sections.

The date of the first arrival of white men in what is now Roane County is not known, but it is known that white men traveled through the area prior to 1740 (*18*). The first permanent white settlement was made in 1791, on the present site of Kingston at the junction of the Clinch and Tennessee Rivers (*17*). The settlement was known as South West Point and marked the upper limit of navigation on the Tennessee River. It rapidly became an important trading center.

[3] Data supplied by the Engineering Service of the Tennessee Valley Authority



A, Most of the crops of the county are produced in valleys, such as this; and most of the forests are on ridges, such as the one in the distant background. *B*, A sinkhole, a common feature in areas underlain by limestone. Sinkholes are caused by differential dissolution of limestone. This one holds water most of the year; others do not.

A, Modern rural home served by electricity. *B*, Electrification is not restricted to the more luxurious rural homes.

Most of Roane County was acquired from the Cherokee Indians by the treaties of 1794 and 1805. The original Roane County was formed from Knox County by an act of the legislature in 1801. The original county did not extend south of the confluence of the Clinch and Tennessee Rivers; but in 1805, when the area south of this point was acquired from the Indians, the county was greatly enlarged by extending it over much of the area south and southwest of this point. Subsequently, small counties were formed from this large one. All the present counties of Morgan, Bledsoe, Rhea, Hamilton, and Sequatchie, and parts of the counties of Cumberland, Grundy, Marion, Franklin, and Loudon originally were parts of Roane County (*4*).

In 1785 (*6*) a road was cut from the Clinch River to Nashville, passing through settlements on the Cumberland Plateau; and after the founding of Knoxville in 1792 the road was extended to that point. This road became one of the most important thoroughfares between eastern and central Tennessee, and it is still much traveled. Regular steamboat navigation as far north as Kingston was started in 1835. As this was as far as the boats could navigate safely, and as most of the freighting was done on the river, Kingston became an important river port and trading center and also a manufacturing center (*6*). The important early industrial establishments of Kingston were cotton gins, sawmills, tanneries, and whisky distilleries (*6*).

Iron mining and smelting were important industries in the early days. An iron foundry, Eagle Furnace (*17*), was established in 1828. It used charcoal and wood for smelting. Coal was discovered in 1840 (*8*), but it was not mined commercially until 1868. The establishment of the village of Rockwood and an iron company in 1867–8 (*5*) was the beginning of modern development in Roane County. A rolling and casting mill was operated in addition to the pig foundry and commercial coal mines. The principal coal mines were at Eagle Furnace, Browntown Slope, Chamberlain, and, after 1890, Harriman. The founding of Harriman and its subsequent development as an important railroad junction gave impetus to local industrial development there. Harriman is of historic interest as the city that grew from a farm of one family in 1890 to an important industrial center with a population of 3,672 in 1892 (*1*).

Most of the early settlers came from Virginia, North Carolina, and South Carolina and the neighboring counties of Knox and Anderson. A few emigrated from Ireland, Germany, and France (*17*). The population of Roane County in 1802 was 412, consisting of 275 whites and 137 Negroes; in 1810, 5,581; in 1880, 15,237; and in 1890, 17,418, all classed as rural. According to the United States census of 1900, the urban population was 6,341 and the rural 16,397. A total population of 24,477, with 8,486 urban, was reported in 1930. The density of the rural population in 1930 was 42.1 persons a square mile.

Kingston, one of the oldest towns in Tennessee, is the county seat. Harriman, the largest town in the county, is an important railway and factory center. Rockwood, the second largest, has some manufacturing enterprises. According to the 1930 census, the population of Kingston was 827; Harriman, 4,588; Rockwood, 3,898; Oliver Springs, 660, of which 565 live in Roane County and 95 in Anderson County. Dyllis, Wheat, Emory, Emory Gap, Glen Alice, and Paint

Rock are trading points and community centers, each having one or two stores, churches, schools, and a few dwellings.

Railroads were built between 1878 and 1890, and following this development the villages of Oliver Springs, Emory Gap, and Glen Alice, with intervening stations, were established. Prior to the completion of the Cincinnati Southern Railroad in 1879 (*17*), the only railroad in the county was one constructed with wooden rails between Rockwood and a point on the Tennessee River where the river steamers were met.

At present the county is served by three railway systems, the Southern, the Louisville & Nashville, and the Tennessee Central. All the railroads traverse the valley adjacent to the foot of the Cumberland escarpment, with the exception of the Tennessee Central Railway, which extends west from Rockwood across the Cumberland escarpment to central Tennessee. The railroads provide rapid transportation facilities to Knoxville, Chattanooga, and Nashville.

This county is well supplied with Federal and State highways. United States Highway No. 70, the main road between Knoxville and Nashville, crosses from east to west. Other important roads are United States Highway No. 27 and three State highways. Communities not on these highways are served by county and community roads, many of which are graveled and most of which are maintained in good condition. All communities are served by roads that are maintained in a passable condition throughout the year.

Farm products are marketed in part locally and in part to outside markets. Most of the wheat, vegetables, dairy products, poultry, and poultry products are consumed at home or sold at the local markets. Practically all of the tobacco is marketed in Knoxville. Much of the corn is consumed locally, but some is shipped to Chattanooga. Peaches and strawberries are shipped via railroad and truck to markets in nearby cities, and, to less extent, to cities in nearby States. Beef and dairy cattle, swine, sheep, and lambs are marketed in Knoxville, Cleveland, Crossville, and Cookeville. Some sheep are sold in Loudon.

The local Farm Bureau provides a cooperative buying service for the county, but at present there is no cooperative selling organization.

All sections of the county are provided with grade schools, most of which are consolidated, although in a few isolated communities two-room schools still remain. High schools are at Harriman, South Harriman, Rockwood, Oliver Springs, Kingston, Wheat, Fairview School, and Paint Rock.

Telephone service is available in the four larger towns and along the telephone lines connecting these towns. About 100 rural homes have telephones.

All the towns are supplied with electricity, which is becoming available also in the rural sections (pl. 2, *A* and *B*). Many of the farms in the communities of Wheat and East Fork Church already have electricity.

The farmhouses, in general, are modest. Most of them are constructed of lumber, and many are in need of repairs and paint. Only a few are equipped with modern conveniences, such as electric lights and running water. Barns and sheds are constructed of lumber; most of them are unpainted, and many are in need of repair.

Harriman and Rockwood are the principal industrial centers, employing labor locally and from adjacent rural districts. The estimated total personnel of the various plants exceeds 4,000 people. The industries in Harriman include extracting acid from chestnut wood and converting the pulp residue into paper, processing lumber, and manufacturing farm implements, hosiery, and woolen blankets. In Rockwood the principal industries are the manufacture of hosiery and silk goods, the manufacture of stoves, and the processing of lumber. Kingston has only one industry of significance, a hosiery mill.

The mining of iron ore and coal, once major industries, have been abandoned in most places. Only two commercial coal mines are now in operation, one at Mount Roosevelt and the other near Cardiff. Coal is mined for local consumption from several small mines along the Cumberland escarpment, but most of the coal used is mined just outside the county, in the vicinity of Oliver Springs.

CLIMATE

The climate of Roane County is of the humid continental type, with moderate winter and summer temperatures.

Rather pronounced local differences in climate are associated with the two major physiographic divisions, the Cumberland Plateau and the great valley. Data indicate that the mean summer rainfall is nearly 20 percent greater and the mean summer temperature is about 5° F. lower on the plateau than in the great valley. The average frost-free period on the plateau is 167 days, and in the valley it is 196 days. The summers on the plateau are more pleasant than in the valley. Summer breezes from the west are cooled while crossing the plateau and, on descending into the valley, have a pleasantly cooling effect in that part of the valley lying at the foot of the Cumberland escarpment. Mean seasonal temperatures in the great valley section are, for winter, 40°; spring, 57.5°; summer, 77.2°; and fall, 59.9°.

The average frost-free period of 196 days in the valley, extending from April 11 to October 24, provides ample time to mature all the crops generally grown. Late frosts in spring sometimes injure some crops, particularly fruits. Frost has been recorded as late as May 10 and as early as September 26.

The winters are generally mild and open, thereby allowing outdoor farm work throughout the season. Although normally some snow falls in the winter, it generally melts within a day or two. On well-drained soils such crops as alfalfa, red clover, crimson clover, winter wheat, winter oats, and winter rye seldom winter-kill. The winters are mild enough to allow the growth of certain winter vegetables.

Although no data of purely local variations in temperature and precipitation are available, it is apparent that such variations do exist. So far as is known, such variations are explained by lay of the land, including direction of slope, the effect of relief on air drainage, differences in elevation, and proximity and relationship to mountains. It is a matter of common observation that frosts frequently occur in valleys and depressions when the vegetation on ridges shows no effects of frost. The early fall and late spring frosts are invariably more injurious in the lower situations. As growth is retarded in the spring, frost injury of fruit trees is less frequent on ridge tops and north-facing slopes than on south-facing slopes.

The mean annual precipitation is well distributed throughout the year, about 80 percent being nearly equally divided among winter, spring, and summer. The lightest precipitation is in the fall, coinciding with the ripening and harvesting of crops. Usually the precipitation is ample for even the most exacting crops, but crops are sometimes injured by periods of too light rainfall, particularly on soils of low moisture-holding capacity, or by too heavy rainfall particularly on soils in the bottoms, which are not very well drained. Much of the rain falls, especially in summer, in rather heavy showers; but most of it, especially in winter, falls in slow gentle rains that last for half a day or more.

Destruction or damage of crops by hailstorms and tornadoes is to be expected, but not frequently.

Table 1, compiled from the records of the United States Weather Bureau station at Loudon, Loudon County, Tenn., gives the normal monthly, seasonal, and annual temperature and precipitation at that place. As Loudon is in the great valley and is only a short distance from Roane County, these data are considered representative of climatic conditions in the great valley section of Roane County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Loudon, Loudon County, Tenn.*

[Elevation, 816 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1930)	Total amount for the wettest year (1932)	Snow, average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December	39.8	76	−4	5.62	3 92	9.83	1.6
January	38.9	74	−5	4.38	2.46	7.14	2 1
February	41.2	80	0	4.36	4 34	7.64	2.0
Winter	40.0	80	−5	14.36	10.72	24.61	5.7
March	47.5	89	8	5 03	5 82	5.77	.6
April	58.2	97	21	4.62	1 86	3.71	.0
May	66 8	99	31	3 77	3 66	3 87	.0
Spring	57 5	99	8	13 42	11.34	13 35	.6
June	75.6	105	41	4 58	2 04	6 70	0
July	78.7	108	46	4.33	1.52	4 17	.0
August	77.2	106	47	4.44	1.64	4.47	.0
Summer	77.2	108	41	13.35	5.20	15 34	.0
September	72.4	106	31	3 38	3.04	2.81	.0
October	59.4	93	24	3.13	2.30	5.85	(1)
November	48.0	85	8	3 44	4.04	5 00	.1
Fall	59 9	106	8	9 95	9 38	13.66	.1
Year	58 6	108	−5	51 08	36 64	66 96	6.4

[1] Trace.

AGRICULTURE

Before the coming of white men, the Cherokee Indians practiced a crude type of agriculture that consisted principally of growing corn and beans (*6*). Early records indicate an abundance of such

wild fruits and nuts as persimmons, plums, apples, mulberries, grapes, blackberries, strawberries, hickory nuts, walnuts, and papaws (*9*). Pawpaw Church is supposed to derive its name from the abundance of papaw trees in the section during Indian occupancy.

Although authentic information about the early agriculture is meager, it is apparent that the white man's first agriculture typified American pioneer life, in that it consisted primarily in growing crops for subsistence. As corn was well adapted to virgin soil conditions, easy to grow, and nonexacting as to time of harvest, had a wide range in adaptability to different soils, and provided a staple food for both man and beast, it was the principal crop of the early settlers. That cotton was also one of the early crops is indicated by the fact that two cotton gins were operating at Kingston in 1809 (*17*). A little flax was grown, mainly for home use. Wheat, oats, rye, and barley were important crops as early as 1840. Horses, cattle, sheep, hogs, and poultry were raised for local needs. Sugar was made first from maple sap and later from sorghum cane (sorgo); clothing (linsey-woolsey cloth) from cotton, flax, and wool. Shoes, furniture, and many farm implements were made at home. Salt pork, corn bread, potatoes, garden vegetables, milk and milk products, chickens, eggs, and wild game constituted the main foods in the pioneer's diet.

Although agriculture has been and still is the main occupation in Roane County, even the early agriculture was supplemented by hunting, lumbering, trading, mining coal and iron, smelting iron, making whisky, and tanning hides.

Early transportation and communication facilities consisted of the rivers, primarily the Tennessee, and crude roads, mainly the road from Knoxville to Nashville. Most of the products, both farm and industrial, that were sold were transported down the Tennessee River and marketed at trading centers along that stream. Although the railroad, completed in 1879, greatly improved transportation and communication facilities, it is significant to note that the greatest agricultural expansion took place before, not after, the coming of the railroad.

In tables 2 and 3 are presented census data on the acreage of the principal crops and the values of the farm products in the county.

In Roane County, corn has been, and still is, the most extensive crop. In 1934 the total acreage of corn was about six times as great as the combined total acreages of wheat, oats, rye, and barley and exceeded the total acreage of all hay and forage crops. Even though the total acreage devoted to corn is still large, it contracted almost one-half from 1879 to 1929, although it expanded somewhat from 1929 to 1934. For the census years since 1889 the yields of corn have ranged from 16 to 23 bushels an acre, the higher yields being obtained in the later years. Corn is grown in all the farming sections and is the principal crop on many farms, particularly the general and subsistence farms. Corn is grown on many different types of soil, as it has a wide range in adaptability to soil conditions; but the yields obtained differ greatly, depending primarily on the type of soil, the kind of soil management, and the variety of corn grown. Much of the corn is consumed on the farm, being used both as feed for livestock and as food for humans. The corn not consumed on the farm is sold, generally at the local markets.

TABLE 2.—*Acreage of the principal crops in Roane County, Tenn., in stated years, as reported by the Federal census*

Crop	1879	1889	1899	1909	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn for grain	33, 261	25, 976	31, 483	27, 775	23, 656	17, 328	19, 963
Wheat	10, 416	5, 909	10, 254	3, 580	5, 555	1, 753	2, 474
Oats	13, 305	12, 736	5, 581	2, 005	1, 012	103	360
Rye	906	98	216	67	241	46	214
Soybeans	-------	-------	-------	-------	-------	2, 473	1, 304
Cowpeas	-------	-------	-------	-------	-------	369	2, 852
All hay	1, 873	5, 477	8, 858	14, 709	17, 747	14, 824	[1] 17, 629
Timothy and/or timothy and clover mixed	-------	-------	-------	2, 069	4	2, 812	[2] 1, 107
Timothy alone	-------	-------	-------	2, 173	497	-------	-------
Clover alone	-------	-------	486	-------	200	990	[3] 5, 978
Alfalfa	-------	-------	9	-------	67	92	124
Other cultivated grasses	-------	-------	6, 089	8, 074	8, 906	7, 264	[1] 5, 987
Legumes cut for hay	-------	-------	-------	-------	5, 218	2, 826	4, 159
Small grains cut for hay	-------	-------	1, 808	1, 763	919	645	274
Wild grasses	-------	-------	466	630	1, 936	195	(4)
Potatoes	-------	392	326	541	368	399	378
Sweetpotatoes	290	336	248	397	334	250	450
Tobacco	22	29	38	7	17	94	156
Strawberries	-------	-------	54	29	14	185	190
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples	-------	44, 319	80, 455	57, 374	35, 190	36, 484	32, 564
Peaches	-------	15, 855	19, 432	43, 822	94, 373	503, 438	301, 603

[1] Includes 494 acres of sorghums for silage, hay, and fodder.
[2] Includes clover (except sweetclover) alone.
[3] Sweetclover and lespedeza (Japan clover) only.
[4] Included with other cultivated grasses.

TABLE 3.—*Value of certain agricultural products, by classes, in Roane County, Tenn., in stated years*

Product	1909	1919	1929
Forest products for home use and sale	-------	-------	$179, 244
Cereals	$386, 559	$1, 092, 972	431, 472
Other grains and seeds	2, 370	7, 687	1, 872
Hay and forage	176, 342	510, 167	239, 434
Vegetables (including potatoes and sweetpotatoes)	99, 244	222, 592	89, 456
Farm garden vegetables (excluding potatoes and sweetpotatoes) for home use only	-------	-------	60, 213
Fruits and nuts	30, 800	116, 273	294, 389
All other field crops	116, 335	19, 303	26, 301
Livestock products:			
Dairy products sold	26, 550	72, 516	94, 143
Poultry and eggs produced	93, 224	168, 964	179, 796
Wool produced	576	795	497
Honey and wax produced	1, 587	4, 581	1, 300
Total	933, 587	2, 215, 850	1, 598, 117

Wheat has been grown on a considerably larger acreage than it is at present, although it was grown on a slightly larger acreage in 1934 than in 1929. Average yields for the census years have ranged from 5 to 9 bushels an acre. Wheatfields are generally distributed over the county. Much of the wheat is ground into flour at local mills and subsequently consumed in the farm home; some is fed to poultry, and some is sold on the local markets.

Fifty years ago, oats were relatively important, but now their acreage is insignificant. The total area devoted to oats declined from 13,305 acres in 1879 to 360 acres in 1934. Average acre yields for the census years have ranged from 7.5 to 10.8 bushels.

Rye occupied 906 acres in 1879, but since then the acreage has been below 250 acres, a very low figure. In 1929 only 46 acres were re-

ported in the county, but in 1934 this had increased to 214. Average acre yields for the census years have ranged between 3.6 and 6.5 bushels.

The total acreage devoted to barley has been less than 25 acres in all the census years except 1934, when it rose to 118 acres.

Although cotton was reported as an important crop in the early agriculture, it has been insignificant since some time prior to the earliest available census figures. The rather cool climate and rather short frost-free period account, to considerable extent, for the lack of expansion of the cotton acreage.

The acreage in tobacco is still low, but it has been steadily expanding since 1909. In 1934 a total of 156 acres was reported, and the average acre yield was 793 pounds. Tobacco is strictly a cash crop, and most of it is sold at the tobacco markets in Knoxville.

The total acreages of potatoes and sweetpotatoes have maintained a more or less uniform level since 1879. In 1934 the census reported 378 acres of potatoes and 450 acres of sweetpotatoes and yams. They are grown in small patches on most farms and for the most part are consumed locally.

Most of the farms have a small garden in which vegetables are grown, mainly for home use, and the excess is sold locally. The 1930 census reports three truck farms in the county. The vegetables commonly grown are peas, beans, tomatoes, turnips, beets, cabbage, lettuce, spinach, carrots, and watermelons. In 1934, 252 acres were devoted to vegetables harvested for sale.

Growing peaches has become a very important enterprise in recent years. The number of bearing trees increased from 19,432 in 1900 to 503,438 in 1930 and decreased to 301,603 in 1935. Peaches are grown on about one-third of the farms. Many of the larger peach orchards are in the vicinity of Kingston and on Black Oak Ridge. The increase in total value of fruits and nuts, from $30,800 in 1909 to $294,389 in 1929, is due mainly to the expansion of peach growing. Apple growing has declined since 1900. In 1935 the census reported 32,564 bearing apple trees. Fruits of minor importance are cherries, pears, plums, grapes, and strawberries. Blackberries, dewberries, raspberries, and huckleberries grow wild, and some are picked for home consumption.

Hay and forage crops are very important. The acreage of lespedeza has increased almost phenomenally during the last few years, and now this is probably the most important single hay crop grown. Lespedeza is grown on practically all of the well-drained soils. Soybeans and cowpeas are grown for hay on many farms. Alfalfa is gaining in importance, but as yet the total acreage is very small. Timothy, red clover, and redtop are less important hay crops. Recent increased use of lime and phosphate has encouraged the growth of more legumes and grasses for hay and forage crops.

Pastures are important in the agriculture of the county. The farm census for 1934 reports 37,205 acres of plowable pasture, 7,336 acres of woodland pasture, and 1,593 acres of other pasture, totaling 46,134 acres, an average of about 25 acres to the farm. The pastures differ greatly in quality; some are very good, but many are very poor.

No great change has taken place in the total number of cattle since the date of the first census figures. The total number of cattle

on farms in 1930 was 7,830, the lowest figure for any census year. By 1935, however, the total number had increased to 10,427, averaging 5.7 head per farm. Dairying and raising beef cattle, or a combination of the two, are important enterprises on a great many farms. Probably about one-half of the cattle are kept for dairy purposes. Most of the dairy cattle are grades of the Jersey and Guernsey breeds. Although probably most of the dairy products are consumed at home, a considerable proportion is marketed as whole milk, some as cream, and a little as butter. Harriman, Rockwood, Oliver Springs, Kingston, and Knoxville are markets for the dairy products. In the 1930 census 30 farms were classified as dairy farms. Many of these are located rather close to either Harriman, Oliver Springs, Kingston, or Rockwood or are fairly close to main roads leading to Knoxville. Most of the beef cattle are grades of the Shorthorn, Hereford, and Aberdeen Angus breeds. In the 1930 census 38 farms are classified as animal-specialty farms. The animals are principally beef cattle.

The census reported 17,755 hogs in 1880, but by 1930 the total number had decreased to 3,296. In 1935, however, the number increased to 5,057, an average of 2.7 head per farm. Most of the hogs are grades or purebred animals of Poland China, Berkshire, Hampshire, Chester White, and Duroc-Jersey breeds. Probably not more than 15 or 20 percent of the hogs are marketed; most of them are slaughtered and consumed in the farm homes.

The number of sheep declined, as did the number of hogs, from 1880 to a low point in 1920 and since then has been gradually increasing, but it is still very low. The 1935 census reports only 741 sheep in the county.

Practically every farm has a flock of poultry. The farm poultry furnishes not only food for the home but also considerable cash income. In the 1930 census, 15 farms were classified as poultry farms. The census figures for 1935 show a total of 72,840 chickens in the county, an average of 39.5 per farm. A small number of turkeys, geese, and ducks are raised. Rhode Island Red, Barred Plymouth Rock, White Leghorn, Brown Leghorn, Black Giant, White Giant, Buff Minorca, and Black Minorca are the principal breeds of chickens.

Summarizing, during the 50 years prior to 1929, the total acreage devoted to grain crops generally decreased, but in the 5 years after 1929 it increased significantly. The numbers of livestock and poultry did not change greatly in the 50 years prior to 1930, with the exception of sheep and hogs, the numbers of which declined to very low figures in 1920 and 1930, respectively. Since 1880, cattle were fewest in 1930. Since 1930, all classes of livestock have increased in numbers. The largest total acreage in hay and forage was reported in 1919; the acreage declined in the next decade but increased between 1929 and 1934. It is interesting to note the coincidence of the decline of acreages in grain crops and certain classes of livestock with the general increase of prosperity in the country as a whole until the crisis of 1929, and then the increase in grain and hay crops and livestock during the ensuing depression. The phenomenal expansion of peach growing in the decade 1920 to 1930 elevated this enterprise to one of great importance in the agriculture of certain parts of this county. The increase in value of agricultural products, as

shown in table 3, is due largely to the expansion in the production of peaches and the increase in the values of livestock and livestock products. The high price level prevailing in 1919 accounts, to a great extent, for the high valuation that year.

Work animals include horses and mules. The number of horses has declined markedly since 1900, whereas that of mules has increased slightly. In 1935 the census reported 731 horses and 1,962 mules, an average of 1.5 animals to the farm.

The ordinary farm is well equipped with farm implements, including turning plows, spike-tooth harrows, disk harrows, bull tongue, one-row corn planter, two-, three-, or four-footed single plows (for intertillage of row crops), mowing machine, hay rake, and wagon. Grain binders and threshers are owned by a few farmers, who do the cutting and threshing for their neighbors. Some machines are owned jointly by two or more farmers. Some of the grain is cut with the old-fashioned cradle. Only a few farmers have trucks or tractors.

Before the white man came to Roane County, practically all of the land was in forest, but after he began to develop the agricultural resources, much of the land was cleared of trees and its use shifted from forestry to agriculture. As the census does not date far enough back, we have no record of the early progress of agricultural expansion. It is evident, however, that most of the expansion took place before 1880 and that a point of near equilibrium between cleared land and uncleared land was reached sometime before 1880. Most of the area in forest is unsuitable for agriculture, owing to undesirable physical characteristics of the land, such as soils unproductive of farm crops, very steep relief, extreme stoniness, or some other undesirable feature or combination of features. Small total acreages have been and are being used for urban developments, mining, and recreation.

Since 1899 some significant changes have taken place in the use of the land devoted to agriculture. The most notable shift has been the decrease of land used for grain crops and the increase of land used for hay and forage. The total acreage devoted to corn, oats, wheat, rye, and barley has decreased more than 50 percent since the turn of the century. On the other hand, the total acreage used for hay and forage has about doubled. A significant increase in the total acreage used for peach orchards has taken place. Probably the amount of idle land has increased since 1900.

Land in farms decreased from 88.4 percent of the area of the county in 1880 to 69.9 percent in 1930, and increased to 78.6 percent in 1935. Since 1880 the average size of farms was largest in 1890—161 acres—and was smallest in 1910—101 acres—when the number of farms reached a maximum. Since 1910 the average size of farms increased to 130.3 acres in 1930, but in 1935 it was 103.7 acres. Most of the farms range between 50 and 175 acres in size. The 1935 census lists only 14 farms of 500 acres or more; and of these, only 5 contained 1,000 acres or more. Although the land in farms was less in 1935 than in 1880, the area of improved land expanded from 77,345 to 99,970 acres between those years.

The rural population of Roane County has been nearly stationary since 1900. The number of farms in the county for the census years

since 1880 has ranged between 1,246 (1890) and 2,008 (1910). The farm census reported 1,843 farms in 1935.

Tenancy has decreased since 1880, when tenants operated 41.9 percent of the farms. In 1935 they operated only 31.4 percent, owners 68 percent, and managers 0.6 percent. Three systems of share rental are in practice.[4] These systems are: (1) Tenant furnishes only the labor and receives one-half of the tobacco crop and one-third of the other crops; (2) tenant furnishes labor, work animals, and one-half of the fertilizer and receives two-thirds of the tobacco and one-half of all other crops; and (3) tenant furnishes all labor, work animals, equipment, fertilizer, and seed and receives two-thirds of all crops.

The census reports a general increase in the number of farms reporting expenses for labor. In 1909, 29.5 percent of the farms reported expenditure for labor, totaling $48,102; but in 1929, 43 percent of the farms reported expenditure for labor, totaling $141,263. The local supply of farm labor is generally sufficient to satisfy the demand except during short seasons, such as grain threshing or fruit picking, when some outside labor may be required. Wages for farm labor generally range between 75 cents and $1.25 a day, with the employer furnishing one or two meals a day. Many of the regular farm laborers are supplied with a house, fuel, a garden plot, and a small pasture, and receive from 50 to 75 cents a day for the days that they actually work for their employers.

According to census figures, the total expenditure for fertilizer and lime increased from $7,306 in 1909 to $30,394 in 1919 and decreased to $21,369 in 1929. The high price level in 1919 accounts in part for the highest total expenditure being at that time, but it is also true that the high prices for farm products at the same time tended to increase the quantity of fertilizer needed. In 1909 only 11.5 percent of the farms reported the purchase of fertilizer; by 1919 this figure increased to 37.3 percent, and by 1929 to 40.6 percent. The decrease in soil fertility, owing to long use of the land; the increase in tobacco acreage, all tobacco requiring fertilization; the increase in pasture and leguminous hay crops, which generally require both lime and phosphate; and education of the farmers are probably the main reasons for the increase in the number of farms using fertilizer and lime. Most of the fertilizer is factory mixed, but some is mixed on the farm, particularly the more intensive farms. Most of the fertilizer is used under corn, tobacco, potatoes, and truck crops. Phosphate fertilizers (mainly 16-percent superphosphate) are used under corn, wheat, oats, and hay crops. Phosphates, in combination with heavy applications of crushed limestone or burned lime, are applied to legumes and grasses. The more popular of the ready-mixed fertilizers for small grain, tobacco, and truck crops are 0-10-4[5] and 3-8-5 mixtures, but such mixtures as 2-9-4, 2-10-4, and 4-12-4 are also used. Some nitrate of soda is used for side dressing some crops, particularly corn.

The total expenditure for feed, according to census figures, increased from $32,411 in 1909 to $75,471 in 1929, and the proportion of all farms that reported expenditures for feed increased from

[4] Information furnished by the Roane County agricultural agent.
[5] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

29.4 percent in 1909 to 49.4 percent in 1929. During this same period there was a significant decrease in all kinds of livestock.

Census figures show that the average dollar value of all farm property per farm in 1880 was $1,607, and in 1930, $4,728. Part of this increase in value per farm is due to an increase in the general price level of land, and some of the increase is due to improvements, such as buildings and fences. Land and the improvements mentioned, make up most of the value. The average value of livestock per farm decreased from 14.7 percent of the total investment in 1880 to 10.9 percent in 1930. The average value of farm implements and machinery has always been low, but it increased from 3.5 percent of the total investment in 1880 to 5.5 percent in 1930. In 1930, land represented 62.4 percent of the total farm investment; buildings, 21.3 percent; implements, 5.4 percent; and domestic animals, 10.9 percent. The average land value, including buildings, in 1930 was $30.33 an acre; in 1935, it was $22.39.

Of the 1,304 farms reported by the census of 1930, 318 are classified as general farms, 64 as cash-grain, 12 as crop-specialty, 79 as fruit, 3 as truck, 30 as dairy, 38 as animal-specialty, 15 as poultry, 465 as self-sufficing, 155 as abnormal, including part-time farms and institutional farms, and 125 are unclassified.

The greatest agricultural expansion in Roane County took place before 1880, and since then changes have been comparatively few. The total acreage in farms, number of farms, average size of farms, improved land per farm, and the total number of cattle, mules, and chickens per farm have not changed greatly since 1880. Changes of importance have been a decrease in total acreage of all grain crops, increase of total acreage of hay and forage crops, a great increase in total number of peach trees, and a significant decrease in total number of sheep, pigs, and horses. The total dollar value per farm has greatly increased. The present agriculture of the county is diversified.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures such as those in road or railroad cuts and other excavations are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil and its content of lime and salts are determined by simple tests. Drainage, both internal and external, and other external features, such as stoniness and relief, or lay of the land, are taken into consideration, and the relation between the soil and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, with special emphasis upon those features influencing the adaptation of the land for the growing of crop plants,

grasses, and trees. On the basis of these characteristics, soils are grouped into classificational units (7). The three principal units are (1) series, (2) type, and (3) phase. In places two or more of these principal units may be in such intimate or mixed pattern that they cannot be clearly shown separately on a map, but must be mapped as (4) a complex. Some areas of land, such as coastal beach or bare rocky mountainsides, that have no true soil, are called (5) miscellaneous land types.

The most important of these classificational units is the series, which includes soils having the same genetic horizons similar in their important characteristics and arrangement in the soil profile and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics, and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may differ within a series. The soil series are given names of places or geographic features near which they were first found. Dewey, Fullerton, Clarksville, and Talbott are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Dewey silt loam and Dewey silty clay loam are soil types within the Dewey series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is generally the soil unit to which agronomic data are definitely related.

A phase of a soil type is recognized for the separation of soils within a type that differ in some minor soil characteristic, which may, nevertheless, have an important practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type certain areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping parts of the soil type may be separated on the map as a sloping or a hilly phase. Similarly, different parts of the same soil type may vary greatly in degree and kind of accelerated erosion, and such differences may be expressed as phases.

The term texture refers to the relative amounts of clay, silt, and various grades of sand making up the soil mass. Light-textured soils contain much of the coarser separates (sands), and heavy-textured soils contain much clay. Structure refers to the natural arrangement of the soil material into aggregates, or structural particles or masses. Consistence is a term that has come into rather recent use as regards soil characteristics, and it refers to such conditions

as friability, plasticity, stickiness, hardness, compactness, toughness, and cementation. Permeability and perviousness connote the ease with which water, air, and roots penetrate the soil. The surface soil ordinarily refers to the lighter textured surface layer, which, in most places, extends to a depth ranging from 6 to 12 inches. The subsoil is the deeper and heavier textured layer, which generally is of uniform color in well-drained soils. The substratum is beneath the subsoil and is characteristically splotched or mottled with two or more colors. Bedrock, as used here, is consolidated rock on which the substratum rests. In a practical sense, the degree of acidity may be thought of as the degree of poverty in lime (available calcium), or as indicating the quantity of lime that should be applied for certain crops, such as many of the legumes. An alkaline soil in this county is rich in available calcium, and a neutral soil contains sufficient lime for any crop commonly grown.

The soil surveyor makes a map of the county or area, showing the location of each soil type, phase, complex, and miscellaneous land type, in relation to roads, houses, streams, lakes, and other local cultural and natural features of the landscape.

SOILS

Soil or land conditions have largely determined local differences in the present agriculture of Roane County. Social and economic conditions have also been influential; but it seems apparent that soil conditions have also determined, to a large extent, prevailing local differences in social and economic conditions. A fairly consistent relationship is manifest between the productivity of the soil and the general well-being of the people living on the land.

On the basis of observations it is more or less apparent that, in Roane County, the more progressive agricultural communities, as expressed by good farmhouses and other farm buildings, good fences, ample farm equipment, good schoolhouses, churches, and good local roads, are in those sections where the soils are prevailingly productive. These communities exist where the Huntington, Pope, Philo, Lindside, Sequatchie, Wolftever, Waynesboro, Nolichucky, and mild slopes of the Dewey and Fullerton soils are extensive. On the other hand, the more modest farmhouses and other buildings, poorer fences, small irregular fields, and poorer schools and churches are generally in those sections where the soils are comparatively low in productivity and physically not well suited to the present agriculture. This is particularly true where the farms are located on such soils as the Colbert, Clarksville, Apison, Lehew, Hector, Muskingum, and strong slopes of the Fullerton and Talbott soils.

It is also evident that the soil conditions have not only influenced the general agricultural development but also the type of agricultural development. For example, the Huntington and Pope soils, which occur in the stream bottoms, are particularly well adapted to the production of corn, and as a result they are used primarily for this purpose. This, in turn, has facilitated the production of livestock where such soils are extensive. Soils such as the Dewey, Fullerton, Nolichucky, and Waynesboro, where they occur on mild slopes, and

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the Sequatchie, Wolftever, and Allen, have a wide range in adaptability and are capable of supporting widely diverse types of farms. It is on these soils, in combination with the Huntington, Pope, Lindside, and Philo soils, that the majority of the crop-specialty and animal-specialty farms and a great number of general farms are located. On the other hand, it is on such soils as the Apison, Lehew, Muskingum, Hector, Jefferson, Clarksville, and strong slopes of the Fullerton and Talbott soils that probably the majority of the subsistence farms are located. It is nevertheless true that some farmers situated on these latter soils, by good management and thrift, have developed their farms beyond what is ordinarily considered the subsistence level in this general area.

The soils of the county differ widely in texture, consistence, reaction, fertility, moisture conditions, relief, and degree of stoniness and erosion; all of which affect productivity, workability, and problems of conservation. The soils exhibit all shades of color from light gray through gray, yellow, and red. The surface soil of most soils is either light gray, brownish gray, grayish brown, or light brown, and the subsoil is some shade of brown, yellow, or red.

Although the texture ranges from loamy sand to clay, fine and very fine sandy loams cover about 44 percent of the county, silt loams cover about 38 percent, and silty clay loams about 10 percent. About one-half of the area of the fine sandy loams is stony, and about three-fourths of the area of the silt loams is cherty. In consistence the soils range from the extreme friability of such soils as the Huntington and Pope to the tough, sticky, and plastic consistence of the Colbert. With the exception of the Huntington, Lindside, and Melvin and the valley phase of the Upshur, all the soils are medium to very strongly acid in reaction. The relief, or lay of the land, ranges from level to steep, with the proportion of total county area in the following relief classes: 10 percent, level or nearly level (slopes less than 2½ percent); 9 percent, undulating (slopes ranging from 2½ to 7½ percent); 22 percent, rolling (slopes ranging from 7½ to 15 percent); 37 percent, hilly (slopes ranging from 15 to 30 percent); 22 percent, steep (slopes of more than 30 percent). Approximately one-fifth of the county has been eroded to the extent that two-thirds or more of the surface soil has been lost. About 46 percent of the land is considered unsuitable for crops or pasture, owing chiefly to one or more of the following features: Strong relief, excessive stoniness, severe erosion, low fertility, or undesirable moisture conditions.

The well-developed soils, which are confined to the uplands and the older terrace lands, have developed in an environment of moderately high temperature, comparatively heavy rainfall, and forest cover. In spite of the fact that the environmental factors of climate and vegetation were similar over most of the county, the well-developed soils differ widely among themselves in morphology, fertility, and productivity. During the history of cultivation, erosion and other artificially stimulated processes of impoverishment have served to intensify local differences in fertility and productivity.

Taking the average of the great valley of east Tennessee as a standard, it is estimated that about 6 percent of that part of the land

considered suitable for cultivation in Roane County is comparatively high in natural fertility and productivity, about 29 percent is medium, and about 65 percent is comparatively low. Most of the soils are deficient in lime, even though many of them have developed from materials weathered from limestones; the lime has been leached out during the processes of rock weathering and soil development. The content of organic matter was not high in any of the soils, even in the virgin state, but there was and still is a relatively wide difference in the content of this constituent among the different soils.

The tilth of most soils is favorable, except on some of the silty clay loams, which are subject to puddling, surface baking, and clodding when tilled under unfavorable moisture conditions. With relatively few exceptions, such refractory surface soils have resulted because erosion has removed much of the original surface soil.

In order to make full use of the soil survey, one must understand the units on the map—units designated as soil types and phases of soil types. As brought out in the section on Soil Survey Methods and Definitions, a phase is merely a subdivision within the type representing a significant variation from the normal soil, generally in either slope or degree of erosion or both. A soil type, in turn, is a subdivision within the soil series—the fundamental unit in the natural classification of soils. After thorough familiarity with the soil series, comprehension of the types and phases within each series is simple and easy. The logical procedure, therefore, in obtaining a working knowledge of the soils of the county is to learn first the characteristics of the soils of the different series.

The fact that soils differ widely in characteristics, such as color, consistence, structure, depth, and other features, has already been brought out. On the basis of these characteristics, the soils of this county have been classified into 27 soil series and 6 miscellaneous land types. Although there is more than one approach to the knowledge of the soil series, a convenient one, and the one presented here, is to associate, first of all, the soils of each series with the position they normally occupy on the broad landscape. Accordingly, the soil series are placed in four groups, as follows: (1) Soils of the uplands, (2) soils of the colluvial lands, (3) soils of the terraces, and (4) soils of the bottom lands. By uplands is meant those lands lying above the stream bottoms, stream terraces, and accumulations of talus and local wash. By colluvial lands is meant those areas where rocks and soil material have accumulated at the foot of mountains, ridges, or hills. Terraces and bottom lands are water made. The bottom lands comprise those soils along the streams and are subject to flooding, whereas the terrace lands are benchlike areas that border the bottom lands but occupy higher positions and are not subject to flooding.

Table 4, which is a key to the soils in Roane County, lists the soil series of the uplands, colluvial lands, terraces, and bottom lands and gives the main characteristics of the soils in each series.

TABLE 4.—*Key to soils of Roane County, Tenn.*

SOILS OF THE UPLANDS

Parent material	Soil series	Dominant relief	Drainage		Surface soil (A horizon)			
			External	Internal	Color	Consistence	Approximate thickness[1]	Co
Residuum derived from weathering of—							*Inches*	
High-grade limestone or dolomitic limestone.	Dewey	Undulating and rolling.	Good	Good	Light brown	Mellow	12	Browni
Moderately cherty dolomitic limestone.	Fullerton	Rolling and hilly	do	do	Brownish gray	Loose	10	Yellowi
Highly cherty dolomitic limestone.	Clarksville	Hilly	do	do	Nearly white	do	10	Yellow
Slightly clayey limestone.	Talbott	Rolling and hilly	do	Fair	Grayish brown	Mellow	6	Yellowi
Highly clayey limestone.	Colbert	Undulating	do	Poor	Brownish gray or olive gray.	Friable	5	Olive y motti
Purple shaly limestone.	Upshur	Rolling	do	Fair	Purplish brown	do	4	Purplis
Interbedded limestone and shale	Armuchee	Hilly and steep	Excessive	Good	Shallow shaly. From 6 to 15 inches deep gray surface soil, yellowish-gray or red			
Acid shales with thin strata of sandstone, some purplish.	Apison	Gently rolling	Good	do	Brownish gray	Loose	7	Browni low.
Purplish interbedded acid shale and sandstone.	Lehew	Hilly and steep	Excessive	do	Purplish gray		6–10	Purplis low t plish
Mainly sandstone, some shale.	Muskingum	do	do	do	Generally grayish yellow.		8–12	Browni low.
	Hector	do	do	do	Grayish brown		8–12	Reddish
	Hartsells	Undulating and rolling.	Good	do	Yellowish gray	Loose	10	Yellow

SOILS OF THE COLLUVIAL LANDS

Colluvium and local wash from— Sandstone outcrops and Muskingum, Hector, and Lehew soils.	Allen	Undulating and rolling.	Good	Good	Grayish brown.	Loose	8	Browni
	Jefferson	do	do	do	Grayish yellow.	do	9	Browni low.
Shale outcrops and Apison soils.	Leadville	Undulating	do	Fair	Brownish gray	do	10	Yellow.
Mainly Clarksville and Fullerton soils.	Greendale	do	do	do	Grayish brown.	do	8	do.

SOILS OF THE TERRACES

Alluvium washed chiefly from uplands underlain by—								
Sandstone and acid shale.	Nolichucky	Undulating and gently rolling.	Good	Good	Yellowish gray	Loose	10	Yellowi
	Waynesboro	Undulating and rolling	do	do	Light brown	do	8	do.
	Sequatchie	Nearly level to undulating.	do	do	do	Friable	10	Yello brown
Mainly limestone, some sandstone and shale.	Wolftever	do	Fair	Retarded	do	Mellow	10	do.

SOILS OF THE BOTTOM LANDS

Alluvium washed mainly from uplands underlain by—					
Limestone	Huntington	Nearly level	Slow	Good	Young soil. Predominantly rich brown sil 30 inches.
	Lindside	do	do	Intermediate	Young soil. Brown to a depth of 12 to 18 i
	Melvin	do	Poor	Poor	Young soil. Mottled gray, yellow, and br
Cherty dolomitic limestone	Roane	do	Good	Fair	Young soil. Grayish-brown cherty loam, a semicemented layer composed largely
Sandstone and acid shale.	Pope	do	Slow	Good	Young soil. Light brown to a depth of mor
	Philo	do	do	Intermediate	Young soil. Grayish brown or yellowish inches; highly mottled below.
	Atkins	do	Poor	Poor	Young soil. Mottled gray, yellow, and br

[1] Where no appreciable accelerated erosion has taken place.

In the following pages the soils of Roane County are described in detail and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 5.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in Roane County, Tenn.*

Soil type	Acres	Percent
Dewey silt loam	832	0.3
Dewey silty clay loam	3,200	1.3
Dewey silty clay loam, hilly phase	3,968	1.6
Dewey silty clay loam, steep phase	1,600	.7
Fullerton cherty silt loam	7,872	3.2
Fullerton cherty silt loam, eroded phase	1,792	.7
Fullerton cherty silt loam, smooth phase	384	.2
Fullerton cherty silt loam, hilly phase	12,864	5.3
Fullerton cherty silt loam, eroded hilly phase	4,928	2.0
Fullerton cherty silt loam, steep phase	8,384	3.4
Rough gullied land (Fullerton soil material)	704	.3
Clarksville cherty silt loam	7,936	3.3
Clarksville cherty silt loam, smooth phase	1,088	.4
Clarksville cherty silt loam, hilly phase	16,960	7.0
Clarksville cherty silt loam, eroded hilly phase	3,008	1.2
Clarksville cherty silt loam, steep phase	9,600	3.9
Talbott silty clay loam	3,776	1.6
Talbott silty clay loam, smooth phase	832	.3
Talbott silty clay loam, hilly phase	3,264	1.3
Rolling stony land (Colbert and Talbott soil materials)	4,736	1.9
Rough stony land (Talbott soil material)	2,368	1.0
Colbert silt loam	1,856	.8
Colbert silt loam, slope phase	1,408	.6
Colbert silty clay loam	6,016	2.5
Upshur silty clay loam, valley phase	1,344	.6
Armuchee silt loam	3,328	1.4
Apison very fine sandy loam	576	.2
Apison very fine sandy loam, eroded phase	512	.2
Apison very fine sandy loam, eroded slope phase	12,736	5.2
Rough gullied land (Apison soil material)	512	0.2
Lehew stony fine sandy loam	17,792	7.3
Muskingum stony fine sandy loam	22,144	9.1
Rough stony land (Muskingum soil material)	9,920	4.1
Hector stony fine sandy loam	9,280	3.8
Hartsells very fine sandy loam	448	.2
Hartsells very fine sandy loam, slope phase	1,920	.8
Mine dumps	256	.1
Allen very fine sandy loam	896	.4
Allen very fine sandy loam, slope phase	6,016	2.5
Jefferson gravelly fine sandy loam	640	.3
Jefferson gravelly fine sandy loam, slope phase	2,752	1.1
Leadvale very fine sandy loam	2,112	.9
Greendale silt loam	1,280	.5
Nolichucky very fine sandy loam	768	.3
Nolichucky very fine sandy loam, slope phase	1,152	.5
Nolichucky very fine sandy loam, eroded phase	1,792	.7
Waynesboro very fine sandy loam	576	.2
Waynesboro very fine sandy loam, slope phase	2,880	1.2
Waynesboro very fine sandy loam, eroded hill phase	1,600	.7
Sequatchie very fine sandy loam	1,856	.8
Sequatchie very fine sandy loam, slope phase	192	.1
Wolftever silt loam	1,536	.6
Wolftever silt loam, slope phase	256	.1
Huntington silt loam	3,904	1.6
Lindside silt loam	896	.4
Melvin silt loam	1,216	.5
Roane gravelly loam	3,584	1.5
Pope very fine sandy loam	9,088	3.7
Pope loamy fine sand	1,728	.7
Pope gravelly fine sandy loam	2,560	1.1
Philo very fine sandy loam	1,920	.8
Atkins very fine sandy loam	1,856	.8
Total	243,200	100.0

SOILS OF THE UPLANDS

All the soils of the uplands have developed from parent material that is residual from the weathering of the underlying sedimentary rocks. These are the dominant soils of the county, as they cover 190,144 acres, or about 78 percent of the total area. They all have good to excessive external drainage and mediocre to very good internal drainage. They differ greatly, however, in morphology, productivity, and use capabilities.

Soils of the Dewey, Fullerton, Clarksville, Talbott, Colbert, and Upshur series are developed from parent material that is residual from the weathering of different kinds or grades of limestone. The Dewey soils come from high-grade limestone or high-grade dolomitic limestone, occur prevailingly on the lower valley slopes, have mainly rolling and hilly relief, have grayish-brown surface soils and

brownish-red or red subsoils, contain a small quantity of chert, and are comparatively high in natural fertility. The Fullerton soils come from moderately cherty dolomitic limestones, occur prevailingly on the upper valley slopes or on rolling ridge tops, occupy chiefly hilly relief, have brownish-gray surface soils and yellowish-red or pale-red subsoils, contain a moderate quantity of chert, and are about medium in natural fertility. The Clarksville soils come from highly cherty dolomitic limestone, occur prevailingly on hilly ridge tops or slopes, occupy mainly hilly and steep relief, have light-gray or nearly white surface soils and yellow subsoils, contain an abundance of chert, and are comparatively low in natural fertility. The soils of the Dewey, Fullerton, and Clarksville series may be thought of as a kind of "family," in which the Dewey soils are the darkest, contain the least chert, have the mildest relief, and are the most productive; the Clarksville soils are lightest in color, contain the most chert, occupy the strongest relief, and are the least productive; and the Fullerton soils are intermediate in these respects between the Dewey and Clarksville soils.

The Talbott soils come from clayey limestones, occur mainly in the valley troughs, occupy chiefly rolling relief, have grayish-brown surface soils and heavy plastic yellowish-red subsoils, generally have numerous limestone outcrops, generally are nearly free from chert, and are about medium in natural fertility. The Colbert soils come from highly clayey limestones, lie in the valley troughs, occupy prevailingly undulating relief, are generally shallow to bedrock, have numerous outcrops of bedrock, have grayish-yellow surface soils and olive-yellow mottled tough plastic and sticky subsoils, are practically free from chert, and are comparatively low in natural fertility. The Upshur soils come from reddish-purple shaly limestone, occur in narrow strips in the valleys, occupy undulating and rolling relief, are shallow to bedrock, have limestone outcrops, have purplish-brown surface soils and purplish-red subsoils, are free from chert, are neutral in reaction, and are medium to low in fertility.

The Armuchee soils come from interbedded limestone and shale, occupy steep valley slopes, are shallow to bedrock (ranging from about 6 to 15 inches thick), have a weakly developed profile with yellowish-gray thin surface soils and reddish-yellow or brownish-yellow subsoils, contain numerous tiny shale fragments, and are medium to comparatively low in fertility.

Soils of the Apison, Lehew, Hector, Muskingum, and Hartsells series come from residuum of sandstone interbedded with acid shale. They are all rather shallow over bedrock, strongly acid in reaction, and low in fertility. The Lehew, Muskingum, and Hector soils are similar in that they have undergone but little development, are stony, have steep relief, and occupy ridges; but they differ in color of the subsoils. The subsoils of the Hector soils are red, those of the Muskingum are yellow, and those of the Lehew are some light shade of purple. Soils of these series are not suitable for crop use. In contrast to the Hector, Muskingum, and Lehew soils, which are stony and have strong relief, the Apison and Hartsells soils are generally nonstony and have mild relief. The Apison and Hartsells soils are similar in color, the surface soils being light colored and the subsoils yellow. The Apison soils, however, come chiefly from

acid shale residuum with only a small admixture of sandstone and occur in the interridge valleys in the great valley section of the county, whereas the Hartsells soils come chiefly from sandstone residuum and occupy the undissected remnants of the Cumberland Plateau. In the uneroded condition the Apison and Hartsells soils are suitable for crop use.

The Lehew, Muskingum, and Hector soils occur on ridges but not on the same ridges as the Clarksville, Fullerton, and Dewey soils. Black Oak, Chestnut, and Copper Ridges are covered chiefly by the Clarksville and Fullerton soils, with some areas of Dewey soils. Ridges such as Dickey, Dug, Pine, Paint Rock, Riley, and Hurricane are covered by the Lehew, Muskingum, and Hector soils. It is also significant that the Lehew soils do not occur in the Cumberland Plateau section of the county. Here only the Muskingum, Hector, and Hartsells soils occur in the uplands. In many of the interridge valleys the Apison soils, which are derived chiefly from acid shale, occupy one side of the creek, and soils underlain by limestone, particularly the Talbott and Colbert soils, occupy the other side.

DEWEY SERIES

The soils of the Dewey series are well drained, both internally and externally; are acid in reaction; are penetrable by air, water, and roots; have a fairly high water-holding capacity; and are comparatively high in natural fertility and productivity. The prevailing relief of these soils in the great valley of east Tennessee is undulating or gently rolling, but in Roane County the relief ranges from gently rolling to hilly. These soils normally occur on the low ridge or valley slopes, but a few areas are mapped on the tops of Black Oak, Chestnut, and Copper Ridges. The parent material is residuum from the weathering of high-grade limestone or high-grade dolomitic limestone. (By high-grade is meant a low content of clay or other impurities.) The parent limestones, particularly the dolomitic limestones, ordinarily contain some chert, and in a few places the chert content is rather high. The native vegetation was forest, mainly oak, hickory, maple, and chestnut.

In uneroded fields the Dewey soils have surface layers of mellow and friable grayish-brown or light-brown silt loam, from 10 to 16 inches thick. This material is underlain by red or brownish-red silty clay that is rather firm but friable, ranging in thickness from about 40 to 50 inches. Underlying this and continuing downward to bedrock is yellowish-red silty clay splotched with yellow, olive yellow, gray, brown, and dark red. This substratum layer normally is moderately sticky and plastic. In most places bedrock is reached at a depth ranging from 15 to 25 feet below the surface; but in some areas the depth is much less, and in a few places bedrock outcrops. In general the rock strata dip considerably. Chert fragments are scattered throughout the soil layers in most places, but ordinarily the content is not high—not more than 10 percent of the soil mass.

Soils of the Dewey series are the southern equivalents of the Hagerstown soils mapped in Virginia, Maryland, and Pennsylvania. They differ from the Hagerstown soils primarily in having more red and less brown coloration in the profile. They differ from the Decatur soils, mapped elsewhere in the great valley, in having lighter

colored surface soils, paler red subsoils, a little higher chert content, shallower subsoil layers, and, in general, a little stronger relief. The Dewey soils differ from the Fullerton soils in that they have darker surface soils, redder and deeper subsoils, less chert throughout the profile, and milder relief. They differ from the Talbott soils in having deeper surface soils and deeper, more friable, and more red subsoils. The Dewey soils are deeper over bedrock than the Talbott. Two soil types and two phases represent the Dewey soils in this county, namely, Dewey silt loam; Dewey silty clay loam; Dewey silty clay loam, hilly phase; and Dewey silty clay loam, steep phase. They cover an area of 9,600 acres, or 3.9 percent of the county. About 42 percent of these soils have undulating or gently rolling relief, 41 percent have hilly relief, and 17 percent have steep relief. More than three-fourths of the total area of the Dewey soils is eroded to the extent that nearly all of the surface layer has been lost. The Dewey soils occur mainly on the lower slopes of Black Oak, Chestnut, and Copper Ridges, and east of Rockwood. The larger areas are in the vicinities of Eureka, Post Oak Springs, Sugar Grove School, Kingston, Cave Creek, and Dogwood Church. The soils occur in geographic association mainly with the Talbott, Fullerton, and Clarksville soils.

The comparatively high productivity, generally good condition of tilth, and rather high fertility of the Dewey soils are properties that make them desirable for agriculture. Generally speaking, of all the soils in the uplands in Roane County, the Dewey are the most productive and best suited to agricultural uses. A detracting feature, however, is their fairly high susceptibility to accelerated erosion, as evidenced by the fact that more than three-fourths of their total area is eroded. Many areas of the Dewey soils have comparatively strong relief, therefore the number of adapted uses for these soils decrease and the requirements of management become more and more exacting. Where they have undulating or gently rolling relief, the Dewey soils are well adapted to the production of practically all of the crops commonly grown; but where the relief is steep these soils can hardly be considered suitable for the production of crops. Under proper management, however, these steep areas are suitable for permanent pasture.

Dewey silt loam.—Dewey silt loam is a well-drained productive soil occupying the gently sloping lower valley slopes and the undulating or gently rolling tops of cherty ridges. It is acid in reaction, permeable to both roots and water, and comparatively high in natural fertility.

In uneroded fields Dewey silt loam has a surface soil of light-brown or grayish-brown mellow silt loam ranging in thickness from about 10 to 16 inches. In comparison with other well-developed soils in the county, the surface layer is relatively high in well-decomposed organic matter. In some areas this layer contains small quantities of angular chert fragments, most of which are from about ½ inch to 1⅓ inches in diameter. In wooded areas the topmost 1- or 2-inch layer is stained nearly black by decomposing organic matter.

The subsoil is rather uniformly colored brownish-red or red silty clay that is rather firm but friable. The soil material breaks out

in rather soft subangular aggregates that are easily crushed to a smooth slightly lighter colored mass. When wet the material is moderately sticky and plastic. This layer normally contains numerous black or dark-brown hard concretions the size of a pinhead and normally has a small quantity of chert scattered through it. In most places the thickness of this layer ranges from about 40 to 50 inches, but in some places it is not more than about 30 inches. Generally the upper part of the subsoil layer is brownish red and the lower part bright red. In most places the upper part is a little more friable than the lower part.

The substratum consists of yellowish-red or reddish-yellow silty clay, profusely splotched with yellow, red, gray, and olive yellow. Like the layer above, it generally contains some chert fragments. The structural aggregates are larger and more angular and the material is generally less friable and more sticky and plastic than that in the subsoil. The thickness of the substratum differs greatly, depending on the depth to the underlying bedrock. In most places bedrock is reached at a depth ranging from about 15 to 25 feet below the surface. The rock floor is very uneven and jagged, and the strata in most places have considerable dip, thereby favoring good underdrainage. The rocks are either nearly pure limestones or dolomitic limestones that are comparatively low in clay impurities and generally contain a little chert.

Some variations are included with Dewey silt loam as mapped. In some places the subsoil is less friable and not so deep as is typical of the Dewey soils; in other places it contains more chert than typical, and in some places the surface soil to a depth of 3 or 4 inches has been removed by accelerated erosion. Areas with these variations are not extensive, and, so far as use capabilities or soil management are concerned, they are not significantly different from typical Dewey silt loam.

The relief of Dewey silt loam ranges from gently undulating to rolling, the slopes ranging from about 3 to 15 percent, with most of the slopes between 5 and 12 percent.

Originally, all this soil was covered with forest, largely of oak, hickory, maple, and chestnut. The undergrowth probably was fairly heavy.

Only a small area of this soil is mapped. It is associated principally with Dewey silty clay loam, and some areas border the Fullerton and Talbott soils. Most of the areas are small, ranging from about 5 to 25 acres in size, and they are surrounded by areas of Dewey silty clay loam, which has a stronger relief than Dewey silt loam. Areas of Dewey silt loam are along the top of Black Oak Ridge, in the vicinities of Kingston, Eureka, and Oral, and southwest of Macedonia Church.

Nearly all of this soil is cleared and is used for agriculture. An estimated 30 percent is used for orchards, mainly peach; about 22 percent for hay; 18 percent for truck crops and tobacco; and the rest for corn, small grains, temporary pasture, and alfalfa. The latter crop occupies a very small acreage. Yields in general are comparatively high. Where the present management is reasonably good, acre yields of 30 to 40 bushels of corn, 15 to 20 bushels of wheat, 1,500 to 2,000 pounds of tobacco, and 3 to 4 tons of alfalfa hay are

obtained. This soil is well adapted to a great number of different uses, including the production of practically all of the crops commonly grown, namely, corn, wheat, oats, rye, barley, lespedeza, alfalfa, red clover, pasture and hay grasses, tobacco, peaches, apples, and vegetables.

The management of this soil differs somewhat from area to area. Where peaches are grown, no rotation of crops is practiced. Where grain and forage crops are grown, some system of rotation is practiced, but the kind of crops in the rotation and the length of the rotation differ. A common rotation consists of corn 1 year, wheat 1 year, and lespedeza 1 year. Frequently some grass, such as timothy or redtop, is grown with or substituted for the lespedeza. Some fertilizer is used on most farms, but the kinds and rates of applications differ. Mechanical measures for the control of erosion, such as terracing, have not become a common practice.

Under reasonably good management and proper use, Dewey silt loam should remain indefinitely a good soil for agriculture. The use and management must be such as to control and make the most efficient use of water, thereby retarding erosion and improving moisture conditions. Properly adjusted crop rotations, proper tillage, and the judicious use of fertilizers, including lime and phosphate, can be expected to maintain this soil in a high state of fertility. Where the soil is used mainly for the production of intertilled crops, terracing or other mechanical measures for the control of water may be required. A good practice is to do all tillage operations on the contour.

Dewey silty clay loam.—The main difference between Dewey silty clay loam and Dewey silt loam is that on Dewey silty clay loam nearly all of the original surface soil has eroded. The soil now classified as Dewey silty clay loam was originally Dewey silt loam, but, subsequent to the clearing of Dewey silt loam and during its use for agriculture, most of the original surface soil has been lost by accelerated water erosion. The remaining fraction of the original surface soil has been incorporated with the upper part of the subsoil by tillage, and the resulting surface soil, ranging from 4 to 8 inches in thickness, is reddish-brown silty clay loam. The characteristics of the subsoil and substratum layers and the parent rocks are the same as those described for Dewey silt loam.

Small areas showing variations in depth, consistence, and chert content, as described for Dewey silt loam, are also included in Dewey silty clay loam. Areas with a heavier texture and a shallower subsoil occur mainly in the vicinities of Cave Creek and Dogwood Church. This soil differs somewhat from place to place in degree of erosion. On some areas with the milder relief, slightly less than two-thirds of the original surface soil has been lost, whereas in other areas, particularly those with the stronger relief, most of the original surface soil and, in places, some of the original subsoil have been lost.

Like Dewey silt loam, Dewey silty clay loam has an undulating to rolling relief, the slope ranging from about 3 to 15 percent, with most of the slopes between 5 and 12 percent.

Most of this soil occurs in areas ranging from 10 to 100 acres with some as large as 400 acres. The largest bodies are near Post Oak Springs and Eureka. The soil is geographically associated with

Dewey silt loam, the hilly and steep phases of Dewey silty clay loam, and the Fullerton, Clarksville, and Talbott soils.

All areas of Dewey silty clay loam have been cleared and used for agriculture for a number of years. It is estimated that about 30 percent of this soil is used for orchards, mainly peaches; about 30 percent for corn, small grain, and truck crops; and about 30 percent for hay and pasture. Probably about 10 percent is idle or reverting to woods, chiefly because of its eroded condition.

Under present management, yields of corn, small grains, and truck crops are probably from 10 to 15 percent lower than on Dewey silt loam. These lower yields are attributed largely to the eroded condition, as a result of which most of the original organic matter and considerable quantities of valuable plant nutrients have been lost, the rate and capacity for absorbing water has been lowered, and tilth properties have been materially impaired. These undesirable results of erosion combine to make management requirements exacting.

The control of water on this soil is an important problem, the solution of which requires carefully adjusted use and management. Generally speaking, the choice and rotation of crops should include fewer row crops and more close-growing or sod-forming crops; tillage should follow contours, and plowing should be done only under favorable moisture conditions; and needed amendments should be judiciously applied. On some farms it may be that this soil can be used to good advantage for permanent pastures, particularly the steeper slopes. In some places terracing, strip cropping, or other mechanical means for the control of water may prove advisable.

Although this soil is in a rather depleted condition, it lends itself well to rejuvenation, chiefly because of its favorable physical and chemical character, the thick subsoil layer, and the great depth to bedrock.

Dewey silty clay loam, hilly phase.—Dewey silty clay loam, hilly phase, is similar in profile characteristics to typical Dewey silty clay loam, but it differs from that soil in having stronger relief. This hilly soil differs from Dewey silt loam both in having stronger relief and in being eroded. Originally, Dewey silty clay loam, hilly phase, had a profile similar to Dewey silt loam; but subsequent to clearing and during its use for agriculture, most of the original surface soil was lost by accelerated erosion, and now the soil profile is similar to that of typical Dewey silty clay loam.

Generally speaking, this hilly soil has lost two-thirds or more of its original surface soil and, in many places, part of the original subsoil. In most places the surface layer now consists of the lower part of the original surface soil and the upper part of the subsoil, which have been mixed by tillage. In most places the 4- to 8-inch surface soil is reddish-brown fairly friable silty clay loam. The subsoil, substratum, and underlying rocks are similar to those of Dewey silt loam except for greater variations in color, thickness, consistence, and chert content.

This is an inextensive soil. It occupies the slopes of Copper, Chestnut, and Black Oak Ridges, which are underlain by dolomitic limestone. The larger areas are in the vicinities of Kingston, Rockwood, Eureka, Sugar Grove School, and Dogwood Church. Individual areas are of irregular shape and range from small to rather

large. This soil occurs in geographic association with other types and phases of the Dewey series and with soils of the Fullerton, Clarksville, and Talbott series.

Practically all areas of this hilly soil have been cleared for a number of years. It is estimated that about 15 percent of the land is used for the production of corn and small grains; about 30 percent is used for hay and pasture; about 20 percent is in orchards, mainly peaches; probably about 25 percent is either lying idle or being used as unimproved pasture; and 10 percent is abandoned, at least temporarily.

In general, yields of crops average a little lower than on typical Dewey silty clay loam and considerably lower than on Dewey silt loam. Acre yields reported range from 15 to 25 bushels of corn, 8 to 12 bushels of wheat, and 1 to 2 tons of hay. The decreased rate of water absorption, resulting largely from the eroded condition and the rapid run-off, owing to the strong relief, are factors that bring about inefficient use of water, and this, in turn, causes crops to suffer from drought during periods of low rainfall.

The none too favorable tilth condition, strong relief, and high susceptibility to erosion make the management requirements of this soil exacting. In any management program the control of water is of primary importance, in order to conserve as much water as possible for use by the crop plants and to prevent further erosion. Tillage should follow the contours, and strip cropping will probably be a good practice where practicable. Although mechanical measures for the control of water, such as terracing or hillside ditching, may be of some benefit, it is doubtful if they would be practical on this hilly soil. Systematic long rotations, in which intertilled crops are reduced to a minimum and close-growing and sod-forming crops are increased to the maximum, and the addition of organic matter, lime, and phosphate, may be expected to increase and maintain the productivity of this soil at a fairly high level.

Dewey silty clay loam, steep phase.—The distinctive feature of Dewey silty clay loam, steep phase, is that it occupies very strong relief, the slope being more than 30 percent, with most areas ranging from 30 to about 45 percent. This soil differs from Dewey silty clay loam, hilly phase, primarily in having a stronger relief. In profile characteristics, soil of this steep phase resembles the soils of the other types and phases within the Dewey series, except that greater variations occur in the soil profile.

In wooded areas, the 6- to 12-inch surface soil is mellow light-brown silty clay loam, the upper inch or two of which is stained dark with well-combined organic matter. The subsoil, substratum, and parent rock resemble the corresponding layers of typical Dewey silty clay loam, except that the thickness of the layers and the depth to bedrock are probably less in areas of the steep phase. Where this soil has been cleared and used for agriculture, it is eroded in a manner similar to that described for soil of the hilly phase, and the two soils are similar in profile features.

This soil, which is not extensive, occurs chiefly in geographic association with other Dewey soils, but some areas border the Fullerton, Clarksville, and Talbott soils. The larger areas are in the vicinities of Dogwood Church and Cave Creek.

Probably from 60 to 70 percent of the total area is still in forest. All the cleared area at some time or other was used for the production of the common crops, but the use of nearly all of it has been changed to pasture, after the soil suffered injury from accelerated erosion. Practically all of the cleared land is moderately to severely eroded.

The steep relief of this soil precludes its feasible use for crop production, even though the other features are desirable. Owing largely to the strong relief, tillage operations are difficult to perform, and, where a rotation of crops including intertilled crops is practiced, conservation of the soil is extremely difficult. As this soil is comparatively fertile and productive, however, its use for pasture is practicable. Under proper management, pastures of good quality and fairly high productivity are to be expected. Preferably, uncleared areas of this soil should be planted to grass immediately after clearing, in order to prevent accelerated erosion with a consequent loss of valuable plant nutrients, decrease in rate of and capacity for water absorption, and impairment of tilth conditions. This soil is well suited to forestry, and whether its best use is for pasture or forest will be determined in many places chiefly by the needs of the individual farm.

FULLERTON SERIES

Soils of the Fullerton series are well-drained, strongly acid, moderately cherty, and moderately productive soils that occupy the rolling and hilly areas on the cherty ridges. The parent material is residuum from the weathering of moderately cherty dolomitic limestone. Originally, this land was forested, mainly with deciduous trees. The Fullerton soils differ from the Dewey soils chiefly in having lighter colored surface soils, paler red and shallower subsoils, more chert throughout the soil mass, in coming from a more cherty dolomitic limestone, and in having a prevailingly stronger relief. They differ from the Clarksville soils mainly in having darker surface soils, yellowish-red rather than yellow subsoils, less chert in the soil material, and in coming from less cherty dolomitic limestone.

In uneroded fields the Fullerton soils have 10- to 15-inch surface soils of brownish-gray silt loam. This is underlain by yellowish-red or light-red firm but moderately friable silty clay or silty clay loam, ranging in thickness from about 25 to 35 inches. Underlying this and continuing to bedrock is a substratum of silty clay that is reddish yellow, mottled with yellow, red, brown, and gray. These layers normally have a moderate quantity of chert fragments scattered through them, the chert content of the plow soils generally being high enough to interfere materially with tillage operations. The parent rock is dolomitic limestone occurring in strata that ordinarily have considerable dip. Depth to bedrock probably ranges from 20 to 30 feet, or a little more than for the Dewey soils.

The Fullerton soils are among the most extensive in the county and cover an aggregate area of 36,928 acres, or 15.1 percent of the area of the county. They occur mainly on Black Oak, Chestnut, and Copper Ridges. Slightly less than 1 percent of this land is undulating, about 25 percent is rolling, about 60 percent is hilly, and about 14 percent is steep. Between one-fourth and one-half of the area of

the Fullerton soils is eroded to the extent that nearly all of the original surface soil has been lost.

The adaptability of the Fullerton soils to agricultural uses depends greatly on their relief and to less extent on their chertiness and degree of accelerated erosion. Where the land has gentle relief and the soil is not very cherty or badly eroded the range of adaptability is wide, but where the land has strong relief and the soil is very cherty or severely eroded the adaptability is correspondingly narrow. In general, the Fullerton soils are less productive than the Dewey soils, but they are less susceptible to erosion than the Dewey soils.

The Fullerton soils in Roane County are classified and mapped in one type, five phases, and one land type, as follows: Fullerton cherty silt loam; Fullerton cherty silt loam, eroded phase; Fullerton cherty silt loam, smooth phase; Fullerton cherty silt loam, hilly phase; Fullerton cherty silt loam, eroded hilly phase; Fullerton cherty silt loam, steep phase, and rough gullied land (Fullerton soil material).

Fullerton cherty silt loam.—Fullerton cherty silt loam is a well-drained soil occurring on the cherty ridges, chiefly in association with the Clarksville soils and other Fullerton soils. Fullerton cherty silt loam is medium to strongly acid in reaction, is permeable to water and roots, is well aerated, and has a moderate water-holding capacity. The content of organic matter in the surface soil is normally lower than in the corresponding layer of Dewey silt loam but is higher than in the corresponding layer of Clarksville cherty silt loam. The natural fertility is lower than that of Dewey silt loam but is higher than that of Clarksville cherty silt loam. Fullerton cherty silt loam has rolling relief, the slopes ranging from about 8 to 15 percent. In this respect it resembles Dewey silt loam and Clarksville cherty silt loam.

In uneroded fields Fullerton cherty silt loam has a brownish-gray loose silt loam surface soil about 10 to 15 inches thick. This layer normally contains a moderate quantity of chert fragments. In wooded areas the topmost 1- or 2-inch layer is stained dark with organic matter.

Underlying the surface soil is the yellowish-red or pale-red silty clay or silty clay loam subsoil, about 25 to 35 inches thick. Under favorable moisture conditions this material is moderately friable; when wet it is somewhat sticky and plastic, and when dry it is rather hard. It has a poorly defined subangular nutlike structure, the aggregates differing in both size and shape. It contains a moderate quantity of chert fragments, most of which range from ½ to 1½ inches in diameter. Underlying the subsoil is the substratum consisting dominantly of reddish-yellow silty clay splotched with yellow, red, brown, and gray. This material generally is rather tight, sticky, and plastic. It contains a moderate quantity of chert fragments, the average size of which is probably a little larger than those in the layer above. The substratum continues to bedrock, which lies from 20 to 30 feet below the surface in most places. The bedrock consists of moderately cherty dolomitic limestone, and the rock strata generally have considerable dip.

A variation included with Fullerton cherty silt loam occurs near the foot of Walden Ridge in the vicinities of Glen Alice and Rockwood, where the soil is lighter textured than normal. The surface

soil in most areas of this variation is light loam, and the subsoil is silty clay loam. In addition to the chert normally occurring in Fullerton cherty silt loam, this variation contains a few small sandstone fragments. Apparently the soil of this variation comes from a dolomitic limestone that is sandy as well as cherty. Another variation included lies at or near the foot of slopes where a small amount of local wash has accumulated, but in other respects this variation is similar to normal Fullerton cherty silt loam. In cleared areas the thickness of the surface layer differs somewhat from place to place, owing to accelerated erosion, and ranges in thickness from about 4 to 12 inches. Included also are a few small areas or patches where nearly all of the original surface soil has been lost by accelerated erosion. These areas are indicated on the map by special symbols.

This soil occurs principally on Black Oak, Chestnut, and Copper Ridges, and some areas are near the foot of Walden Ridge. They are closely associated with the Clarksville, Dewey, and other Fullerton soils. The areas near the foot of Walden Ridge are associated with the Clarksville, Allen, and Muskingum soils. Areas of Fullerton cherty silt loam differ in both shape and size, but few bodies exceed 50 acres in size.

It is estimated that only about 10 percent of the total acreage of Fullerton cherty silt loam is still in woods, and most of this consists of small bodies that are more or less isolated by nonagricultural land. An estimated 20 percent of the land is devoted to corn, 12 percent to small grains, 8 percent to truck crops and tobacco, 30 percent to hay and pasture, and 20 percent to orchards, mainly peach. Acre yields are about 20 bushels of corn, 8 to 10 bushels of wheat, 1,200 to 1,500 pounds of tobacco, and 1 to 1½ tons of hay. Lespedeza is the main plant used for the production of hay on this soil. Common lespedeza is the predominant variety, although some of the other varieties are grown.

The management of Fullerton cherty silt loam differs somewhat from place to place. On the whole, however, this soil is given the same kind of management as Dewey silt loam. Where it is used for the production of corn, wheat, and hay, generally some kind of rotation is practiced, the most common being corn 1 year, wheat 1 year, and lespedeza 1 year. Frequently some grass, such as timothy or redtop, is grown with or substituted for lespedeza in the rotation. Some fertilizer is generally used for these crops, but the kinds and quantities differ. Mechanical measures for the control of water, such as terracing, generally have not been taken.

As this soil is low in lime and presumably in phosphate, increased yields of crops are to be expected from applications of these constituents. In fact, they may be necessary before legumes other than lespedeza can be successfully grown. Tillage operations should be performed on the contour. The practicability and necessity of terraces or other mechanical means for the control of water and erosion are somewhat questionable, particularly if a systematic rotation that includes close-growing crops or sod crops is followed. In order to increase crop yields and maintain them at a moderately high level and at the same time conserve the soil, proper liming and fertilization are required. A rotation of crops is required that is not more than 3 years long and includes a legume crop or two.

Fullerton cherty silt loam, eroded phase.—In profile features Fullerton cherty silt loam, eroded phase, resembles typical Fullerton cherty silt loam in all essential respects except that soil of the eroded phase has lost all or nearly all of its original surface soil. The remaining thin layer of the original surface soil has been incorporated with the upper part of the subsoil by tillage operations, and the surface soil now consists of grayish-brown or reddish-brown heavy silt loam ranging in thickness from about 3 to 6 inches. The subsoil, substratum, and parent rocks resemble those of typical Fullerton cherty silt loam. Although this eroded soil phase has a wider range in relief, the slopes ranging from about 3 to 15 percent, most of the slopes range from about 8 to 15 percent.

Owing chiefly to erosion, which has removed practically all of the original organic matter, impaired tilth conditions, and reduced the rate and capacity of the soil for water absorption, this soil is lower in productivity and has a narrower range of adaptability for crops than has typical Fullerton cherty silt loam.

This soil is less extensive than the typical soil. It occupies areas of different sizes and shapes, most of the individual areas being less than 50 acres in size. It occurs in geographic association with other Fullerton soils and with Clarksville and Dewey soils. Areas are scattered promiscuously over Copper, Chestnut, and Black Oak Ridges and on the slopes of these ridges.

All areas of this soil have been cleared for a number of years. It is estimated that about 50 percent of the total area is lying idle or is being used as unimproved pasture. In most of these areas broomsedge is the dominant plant. It is associated with such vegetation as common lespedeza, smilax, poverty oatgrass, cinquefoil, aster, blackberry, and sprouts of trees such as pine, oak, hickory, sassafras, persimmon, and sweetgum. The areas have a low value for pasture. The rest of the soil is used chiefly for the production of corn, small grains, and lespedeza for hay. Acre yields are estimated to be from 10 to 20 percent lower than on uneroded Fullerton cherty silt loam. Burley tobacco does not appear to grow well on this eroded soil. The management where this soil is being used for crop production is similar to that practiced on uneroded Fullerton cherty silt loam. The problem of proper soil management is similar to that on Dewey silty clay loam.

Fullerton cherty silt loam, smooth phase.—The significant difference between Fullerton cherty silt loam, smooth phase, and typical Fullerton cherty silt loam is that this smooth soil has a milder relief, the slopes ranging from about 3 to 8 percent, whereas for typical Fullerton cherty silt loam the slopes range from about 8 to 15 percent. In profile features, this smooth soil resembles the typical soil except that the several layers of the smooth soil probably average a little thicker and, in a few places, approach the Dewey soils in color. Owing chiefly to the fact that this smooth soil has milder relief than typical Fullerton cherty silt loam, its value for agriculture is greater. As compared with the typical soil, this soil is less susceptible to erosion, has a wider range in adaptability, and has less exacting requirements for management. In productivity of the common crops, this soil ranks somewhat lower than Dewey silt loam.

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Only a very small total area is mapped. This soil occurs in small areas scattered over Chestnut Ridge, and in the vicinity of Pawpaw Church and Oral near the eastern edge of the county, and east of Rockwood. It is geographically associated with other Fullerton soils and with the Clarksville and Dewey soils, and in general it lies either on the undulating ridge crest or on the low ridge slopes.

Practically all areas of this soil have been cleared and are used for agriculture. It is estimated that about 50 percent of the land is used for the production of corn and small grains, 2 percent for tobacco, 26 percent for hay and pasture, and 22 percent for fruit, mainly peaches. Tobacco and corn yields frequently reported by farmers are 1,500 pounds and 25 bushels per acre, respectively. The prevailing system of management is similar to that described for Fullerton cherty silt loam. Soil of this smooth phase has a moderately wide range in adaptability to different crops.

Fullerton cherty silt loam, hilly phase.—The main difference between Fullerton cherty silt loam, hilly phase, and typical Fullerton cherty silt loam is that soil of the hilly phase has stronger relief, the slopes ranging from about 15 to 30 percent, whereas the typical soil has slopes ranging from about 8 to 15 percent. The profile features are similar except that in soil of the hilly phase the surface soil will probably average a little less thick. Variations similar to those included in typical Fullerton cherty silt loam are included in this hilly soil. Most areas of the sandy variation lie close to the Cumberland escarpment. Many areas that have been cleared and used for crops are slightly to moderately eroded. Owing to the impracticability of mapping them separately, small areas of Clarksville cherty silt loam, hilly phase, and Dewey silty clay loam, hilly phase, are included in areas mapped as Fullerton cherty silt loam, hilly phase.

Fullerton cherty silt loam, hilly phase, occupies a large total area, mainly in association with Clarksville and Dewey soils and with other Fullerton soils. It occupies hilly areas on Copper, Chestnut, and Black Oak Ridges and occurs in other sections underlain by dolomitic limestone. Some of the larger areas lie between Mary Crabtree School and Kingston, and near New Hope School and Eureka.

Owing largely to the pronounced relief, soil of this hilly phase is not so desirable for agriculture as is typical Fullerton cherty silt loam. The hilly soil has a much narrower range in adaptability to crops, has more exacting requirements of management, and is generally a little lower in productivity. It is also somewhat lower in productivity than Dewey silty clay loam, hilly phase, but higher than Clarksville cherty silt loam, hilly phase. Control of run-off and erosion is made difficult and the workability of the soil is significantly handicapped by the pronounced relief.

It is estimated that between 60 and 70 percent of the area covered by this soil has been cleared and used for the production of crops, although a large part of the once-cultivated land has been abandoned or turned into pasture. Broomsedge is the dominant plant on most of these areas, and the pastures are of poor quality except where the management has been good and includes the application of lime and phosphate (pl. 3, *A*). Cultivated areas are used mainly for the production of corn, small grains, peaches, and hay. Lespedeza is

A, Representative view of Fullerton cherty silt loam, hilly phase. Permanent pasture is being established on this recently cleared field. This soil is not well suited to intertilled crops, chiefly because of its steep slope and low natural fertility. *B*, Rolling stony land (Colbert and Talbott soil materials) on the hillside.

the chief hay crop. Yields are generally somewhat lower than on typical Fullerton cherty silt loam.

The relief of this soil does not completely preclude its use, however, for crop production, particularly on the milder slopes; but it does make requirements of management exacting and limits the use possibilities of the land. Conservation of this soil under cultivation requires the use of close-growing crops, such as wheat, legumes, and grasses, comparatively long rotations, application of lime and other amendments, and tillage on the contour. The practicability of using terraces or other mechanical measures for the control of water is doubtful. This soil is better adapted to permanent pasture than to cultivated crops. Keeping a permanent cover on it will, to a large degree, prevent deterioration from erosion, but the production of good pastures will require good management, including the application of lime and phosphate.

Fullerton cherty silt loam, eroded hilly phase.—The principal difference between Fullerton cherty silt loam, eroded hilly phase, and the hilly phase just described is that the eroded hilly phase has lost all or nearly all of its original surface soil, whereas the uneroded hilly phase still retains much or nearly all of its original surface soil. The two soils also differ in their respective ranges of relief, the slopes of the eroded hilly soil ranging from approximately 15 to 45 percent and those of the uneroded hilly soil from approximately 15 to 30 percent. The eroded hilly soil resembles Fullerton cherty silt loam, eroded phase, except that it varies more, particularly in the thickness of the soil layers, color, content of chert, and depth to the underlying bedrock. A few gullies, most of them from 2 to 4 feet in depth, are on areas of this eroded hilly soil.

This soil occurs mainly in geographic association with other Fullerton soils and with the Clarksville soils. It occupies hilly and steep areas on Walker, Copper, Chestnut, and Black Oak Ridges. The larger areas are in the vicinities of Kingston, Harriman, and Oral. The individual areas differ in size and shape, but few exceed 100 acres.

Originally this eroded hilly soil was similar to the uneroded hilly soil, having the same limitations in regard to natural adaptability to crops and the same requirements in regard to management. Because of improper use and management, water was not adequately controlled, and accelerated erosion, which, in turn, lowered the productivity, further aggravated the already difficult problem of soil conservation and impaired tilth conditions so that this soil now has a lower rate and capacity for the absorption of water than formerly. Practically all of the original organic matter has been lost, chert fragments on the surface have become more abundant, the moisture range under which the soil can be tilled has been narrowed, and the soil has become susceptible to puddling.

Much of the area occupied by this soil is abandoned, much is being used as unimproved pasture, some is still being used for crops and orchards, and a little is being returned to woods. The crops grown are corn, small grains, and hay. Crop yields generally are low and uncertain. Lespedeza is the main hay crop. Most of the pasture on this soil is of rather poor quality, as the predominant plant in most places is broomsedge, which has little value for pasture.

A small proportion of the land is used for the production of fruits, mainly peaches. Many areas of this soil were formerly used for the production of peaches, and some still have comparatively old peach orchards growing on them; but on numerous areas, particularly in the vicinity of Kingston, the production of peaches has been abandoned.

Owing largely to the strong relief, augmented by the injurious effects of erosion, this soil can hardly be considered suitable for the production of crops, and the practicability of using it even for pasture is questionable. Its most feasible use would seem to be for forestry, and much of it should be thus utilized, at least for a period of rehabilitation. Some areas of this soil, however, may be urgently needed for crops, pasture, or both. Where this is necessary, cropping should be attempted on only the milder slopes; and, if further deterioration is to be prevented, careful adjustment of use and management must be practiced. A long rotation, consisting principally of close-growing crops and the judicious application of needed amendments, particularly phosphate, is probably necessary. The practicability of terraces or other mechanical means for the control of run-off is doubtful. Where pastures are desired, good management will be required, particularly emphasizing the application of lime and phosphate. Where soil of this eroded hilly phase is to be used for either crops or pasture, even moderate yields are not to be expected except under favorable weather conditions.

Fullerton cherty silt loam, steep phase.—Fullerton cherty silt loam, steep phase, resembles Fullerton cherty silt loam, hilly phase, but differs from it in having more pronounced relief. The slope of this steep soil generally exceeds 30 percent. The soil layers probably average a little thinner than those of typical Fullerton cherty silt loam. Considerable variation also occurs in this steep soil, and, as it is impracticable to separate them on the map, small areas of Dewey and Clarksville soils on correspondingly steep slopes are included.

This soil covers a fairly large total area, chiefly in association with the Clarksville soils and other Fullerton soils on Copper, Chestnut, Walker, and Black Oak Ridges and along the Tennessee River southwest of Kingston. Some of the larger areas are near Sugar Grove School, near Gravel Hill School, and southeast of Jonesville.

It is estimated that about 85 percent of the total area is still in woods, in which the predominant trees probably are oak, hickory, poplar, and dogwood. Although nearly all of the cleared areas have been cultivated, most of them are now abandoned for crops and are either being used for pasture or being returned to woods. Peach orchards occupy a few small areas. Considerable erosion has taken place on most of the cleared areas.

The very strong relief of this soil precludes its use for crops, and its use even for pasture is not very profitable, although it is possible in some areas. In addition to its unfavorable relief, this soil is medium to low in productivity, is cherty, subject to accelerated erosion on the steep slopes, and is not naturally well adapted to pasture grasses. Careful management of pastures is necessary to prevent deterioration of the soil. The best use of this soil apparently is for forestry.

Rough gullied land (Fullerton soil material).—This land type includes predominantly severely gullied areas of Fullerton soils, but severely gullied areas of Clarksville, Dewey, Talbott, Colbert, Armuchee, and Waynesboro soils are also included. The slopes of most areas of this land range between approximately 6 and 40 percent, with most of them between 8 and 25 percent. A network of gullies has destroyed the former soil layers, and the designation, rough gullied land, does not represent true soils but the condition resulting from the loss of the soils. Accelerated erosion has injured the land so much that individual landowners ordinarily cannot afford to reclaim it for crops or pasture. Reclamation requires mechanical measures, such as check dams, diversion terraces, ditches, and revegetation. At least several years would be required for the reclamation of these areas.

A small total area is mapped. Bodies of this land type are scattered chiefly over those sections of the county underlain by limestone, among areas of Fullerton, Clarksville, Dewey, Talbott, Colbert, Armuchee, and Waynesboro soils.

Nearly all of this land was once adapted to agricultural use. It was cleared, put under cultivation, and allowed to erode to the extent of almost total destruction. Now, practically all of the land is abandoned for crop use, and, although some is being used for pasture, the pasture is nearly worthless. Much of this land is slowly reverting to woods, with pines and other species of trees reestablishing themselves. Where black locust is planted, it appears to survive and grow fairly well.

CLARKSVILLE SERIES

Soils of the Clarksville series are locally referred to as white gravelly land. They occupy steep, hilly, and rolling areas on ridges underlain by cherty dolomitic limestone, as on Walker, Chestnut, Copper, and Black Oak Ridges. Their light color and high chert content are conspicuous. Like the Fullerton soils, the Clarksville soils are developed from the residuum of cherty dolomitic limestone under a deciduous forest cover. Soils of these two series are well drained and resemble each other somewhat in profile characteristics, but the Clarksville soils contain more chert and have lighter colored surface soils and yellow rather than yellowish-red subsoils.

In uneroded fields the Clarksville soils have surface soils of very light gray or almost white to yellowish-gray loose cherty silt loam ranging in thickness from about 8 to 14 inches. This material is underlain by a subsoil consisting of yellow or brownish-yellow silty clay loam or clay loam about 16 to 20 inches thick and containing an abundance of chert fragments. Underlying this is the substratum of rather sticky and plastic silty clay or silty clay loam, which is reddish yellow or yellowish red, mottled with red, yellow, gray, and brown. Chert fragments are numerous. This layer, which is many feet thick, continues downward to the cherty dolomitic limestone. In most places the depth from the surface to bedrock ranges from 20 to 40 feet. In many places the topmost 8- to 16-inch layer of the substratum is somewhat hard and brittle, suggesting an incipient hardpan.

The Clarksville soils are extensive throughout the entire great valley section of eastern Tennessee. In Roane County they are the most extensive soils, covering a total area of 38,592 acres, or 15.8 percent

of the county. They occur mainly on Walker, Copper, Chestnut, and Black Oak Ridges and in the section south and east of Rockwood. They are associated chiefly with the Fullerton soils and to less extent with the Dewey soils. About 2 percent of the Clarksville soils have undulating relief, 18 percent rolling relief, 56 percent hilly relief, and 24 percent steep relief. Between 10 and 20 percent of these soils have been eroded to the extent that nearly all or, in places, all of the surface soils have been lost. The proportion of eroded soil is much lower than that of the Dewey soils and considerably lower than that of the Fullerton soils. The comparatively small extent of erosion on the Clarksville soils is due mainly to the large proportion of woodland, the porous character of the soils, and the high content of chert.

Compared with other soils in the county, the Clarksville are among the lowest in natural fertility; they rank far below the Dewey soils and somewhat below the Fullerton soils. Their immediate response to fertilization is very good but probably is not so lasting as that of the Dewey and Fullerton soils. They are strongly to very strongly acid in reaction and therefore in great need of lime. Their water-holding capacity is considerably below that of the Dewey soils and somewhat below that of the Fullerton soils. Adaptability of the Clarksville soils to agriculture depends to a great extent on their relief and their content of chert. Where the relief is gentle they can be used for the production of practically all of the common crops, but only moderate yields are to be expected. Alfalfa probably would not succeed well, but truck crops and tobacco seem to do well where properly fertilized. The moderate to high chert content impairs the workability of these soils somewhat. Where the relief is steep, these soils have a narrow range in adaptability. Most of them are very poorly adapted to crops and only moderately adapted to pasture. They are probably best adapted to forestry.

The Clarksville soils in Roane County are mapped and classified in one type and four phases, namely, Clarksville cherty silt loam; Clarksville cherty silt loam, smooth phase; Clarksville cherty silt loam, hilly phase; Clarksville cherty silt loam, eroded hilly phase; and Clarksville cherty silt loam, steep phase.

Clarksville cherty silt loam.—Clarksville cherty silt loam is one of the lightest colored and chertiest soils in the county, and locally it is referred to as white gravelly land. It has rolling relief, the slope ranging from about 8 to 15 percent, and it occupies positions on the rolling ridges underlain by cherty dolomitic limestones, such as Walker, Chestnut, Copper, and Black Oak Ridges. It is moderately to rather high in content of chert, low in content of mineral plant nutrients and organic matter, low in water-holding capacity, and strongly to very strongly acid in reaction. The surface soil and the subsoil are rather porous, well aerated, and easily penetrated by water and plant roots. This soil is comparatively low in natural fertility—much lower than Dewey silt loam and somewhat lower than Fullerton cherty silt loam.

In uneroded fields, Clarksville cherty silt loam has a very light gray, almost white, or light yellowish-gray loose and open silt loam surface soil, ranging in thickness from about 8 to 14 inches, and containing a moderate quantity of chert fragments, which range

from ¼ inch to 2 inches in diameter. In wooded areas the topmost 1- or 2-inch layer is stained dark with organic matter and the rest of the surface soil has a slight yellow cast. The subsoil ranges in thickness from about 16 to 20 inches and consists of yellow or brownish-yellow slightly brittle but friable silty clay loam or clay loam. Under normal moisture conditions the material crumbles easily. Chert fragments are moderately abundant, the average size being probably just a little larger than in the layer above. The substratum, which is many feet in thickness, continues down to the cherty dolomitic bedrock, which lies from 20 to 40 feet below the surface. As in the surface soil and subsoil, chert is present in the substratum; but the distribution is not so uniform, and the chert fragments in general are larger, some of them being as much as 1 foot in diameter. The material is rather sticky and plastic reddish-yellow or yellowish-red silty clay or silty clay loam, mottled with red, yellow, gray, and brown. In many places the substratum, to a depth of 1 foot, is somewhat hard and brittle—suggestive of an incipient hardpan.

Several variations from typical Clarksville cherty silt loam are included in mapping, the main variation being a lighter textured surface soil. This variation occurs chiefly in the vicinity of Glen Alice and south of Rockwood. The soil in these areas has a loam or fine sandy loam surface soil and a fine sandy clay or clay loam subsoil. The color and consistence correspond closely to those of typical Clarksville cherty silt loam. The chert content is about the same, but in addition the sandy variation contains a few sandstone fragments. Another variation is in the thickness of the surface soil, where considerable accelerated erosion has taken place. Here, the surface soil is correspondingly shallow and the accumulation of chert on the surface is greater. Areas of this variation are of small extent. Other variations are in color, toward that of the Fullerton soils, and in content of chert, which in some places is higher than typical and in others lower.

Clarksville cherty silt loam occurs chiefly on rolling ridge crests and lower ridge slopes in association with the Fullerton soils and other Clarksville soils. Rather extensive areas are on Walker, Copper, and Chestnut Ridges and in the vicinities of Compromise School, Oral, New Zion Church, Hopewell School, Poplar Springs School, Oak Hill School, Rockwood, and Cedar Grove Church.

Low natural fertility and more or less isolation by hilly and steep phases of Clarksville and Fullerton soils have kept a large proportion of the land—almost one-half—in woods. It is estimated that about 10 percent of the soil is used for the production of corn, 5 percent for small grains, 10 percent for hay (mainly lespedeza), 4 percent for fruits (mainly peaches), 1 percent for truck crops (mainly strawberries) and burley tobacco, 15 percent for pasture, and 10 percent is lying idle. Yields are generally lower than those obtained on Fullerton cherty silt loam. Acre yields frequently reported are as follows: Corn, 10 to 15 bushels; wheat, 6 to 8 bushels; hay, ½ to 1 ton; and tobacco, 600 to 800 pounds. Most of the pastures are of comparatively low quality, except those that are well managed. Where lime and phosphate have not been applied, the pasture vegetation is largely dominated by broomsedge, which has low value for grazing. Lespedeza is the main hay crop; other hay

crops are redtop and timothy, frequently grown in combination with lespedeza. The idle land is reverting to woods.

The management of this soil differs somewhat from place to place. A fairly common rotation used is as follows: Corn, 1 year; small grain, 1 year; and lespedeza, 1 or 2 years. Frequently some grass, such as redtop or timothy, is grown in conjunction with or substituted for the lespedeza. Some fertilizer is used by most farmers, but the kinds and quantities applied differ. Mechanical measures for the control of water, such as terracing, are not practiced on most farms.

With its present deficiency in lime, about the only legume that can be grown successfully on this soil is lespedeza, which, however, seems to be fairly well adapted. If the land is properly fertilized, burley tobacco of excellent quality can be produced. Truck crops, particularly strawberries, seem to be well adapted to this soil, and peaches produce fairly well. The chert content is high enough and the relief strong enough to make tillage operations somewhat difficult.

As stated above, the yields of most crops on Clarksville cherty silt loam are low, but the response of this soil to good management is very encouraging, some evidence indicating that its response to fertilization is greater than that of the Dewey soils but that the beneficial effects are not so lasting. This would indicate that under good management, application of lime should be lighter but more frequent than on the Dewey soils. Applications of phosphate and probably other amendments, are required in addition. Frequent incorporation of organic matter is desirable. Under good management, yields of corn, small grains, and hay should increase greatly.

Clarksville cherty silt loam, smooth phase.—The smooth phase is distinguished from typical Clarksville cherty silt loam chiefly by its gentler relief; its slope ranges from 3 to 8 percent, whereas that of the typical soil is from 8 to 15 percent. In relief it resembles Fullerton cherty silt loam, smooth phase. In profile features this smooth soil resembles typical Clarksville cherty silt loam, except that the layers in the smooth soil probably average a little thicker and contain a little less chert. Like the typical soil, this smooth soil is low in natural fertility, but its gentler relief somewhat enhances its value for agriculture.

Variations similar to those included in typical Clarksville cherty silt loam are included in soil of the smooth phase. In addition, an inclusion has developed from material in sinkholes and in depressed areas contiguous to heads of drains, part of which has been transported as colluvium and accumulations of local wash at the foot of slopes. This transported material has been washed chiefly from slopes of the Clarksville soils, and the accumulations range in thickness from a few inches to probably a foot or more. The soil developed in such places resembles the typical Clarksville soils, but it is generally a little lower in chert, higher in silt, and probably not so well drained internally. In some places it contains a few concretions. The soil of this variation is a little more productive than typical Clarksville cherty silt loam, but otherwise it has similar agricultural relationships. Its total area is estimated to be about 350 acres. The soil of this variation occupies similar positions as and somewhat resembles Greendale silt loam.

Clarksville cherty silt loam, smooth phase, is of small extent. Areas of this soil are scattered over the cherty ridges, such as Chestnut Ridge, chiefly in association with other Clarksville soils and to less extent with Fullerton soils. It generally occupies the small undulating areas on the ridge crests, but some of it is mapped on the lower slopes of the ridges.

About 25 percent of the total area of this soil is still uncleared. One of the main reasons for this is that many of the areas on the ridge crests are more or less isolated by the hilly and steep phases of the Clarksville and Fullerton soils, which are unadapted to crops and rather poorly adapted to pasture. It is estimated that about 30 percent of the soil of the smooth phase is used for crops, mainly corn, small grains, and lespedeza, and that about 45 percent is used for pasture. Crop yields are about the same as or just a little higher than those obtained on typical Clarksville cherty silt loam. Most of the pastures are of medium or low quality, depending on the management.

The requirements of management are not significantly different from those of typical Clarksville cherty silt loam. Lime and other plant nutrients are greatly needed, but the control of run-off and erosion is a minor problem. The natural adaptability and use capabilities are about the same as those for typical Clarksville cherty silt loam.

Clarksville cherty silt loam, hilly phase.—The main difference between Clarksville cherty silt loam, hilly phase, and typical Clarksville cherty silt loam is that soil of the hilly phase has stronger relief; the slope ranges from 15 to 30 percent, whereas on the typical soil the slope ranges from about 8 to 15 percent. Features of the profile are similar, except that the surface soil of the hilly phase probably averages a little less in thickness and contains a little more chert. Variations similar to those included in typical Clarksville cherty silt loam are included in this hilly soil. Most areas of the sandy variation lie close to the Cumberland escarpment. Soil of the hilly phase has a relief similar to that of Fullerton cherty silt loam, hilly phase; Fullerton cherty silt loam, eroded hilly phase; and Dewey silty clay loam, hilly phase.

Clarksville cherty silt loam, hilly phase, occupies a large total area, or 7 percent of the county. Extensive areas of this hilly soil occur on all the cherty ridges, such as Walker, Copper, Chestnut, and Black Oak Ridges, and in the vicinity of Rockwood. In many of these areas this soil predominates over the Fullerton soils and the other Clarksville soils, with which most of it is associated.

It is estimated that about 75 percent of the total area occupied by this soil is still in woods. Deciduous trees, mainly oak, hickory, maple, poplar, sweetgum, and dogwood, make up most of the forest. About 10 percent of the land is used for crops, chiefly corn, small grains, hay, and fruit, and yields of most crops are low. About 15 percent is used for pasture, much of which is of rather poor quality, consisting chiefly of broomsedge; but under good management, including the application of lime and phosphate, the pasture is of reasonably good quality. Lespedeza is grown rather extensively for pasture. Some redtop, orchard grass, and timothy are used as pasture grasses. Bluegrass and white clover are not well adapted

to this soil except where sufficient lime and phosphate have been applied. Alfalfa does not grow well, unless heavy applications of both lime and phosphate are applied.

Owing chiefly to the scarcity of mineral plant nutrients and organic matter, the moderate to high content of chert, and the strong relief, this soil is very poorly adapted to crops. Although it is not well adapted to pasture, it can be used for this purpose, under good management and the application of lime and phosphate. Broomsedge and other undesirable plants replace the commonly planted pasture plants unless lime and other needed amendments are applied. The immediate response of this soil to fertilization is very good, but, according to farmers, the beneficial effect is not so lasting as in the Dewey and Fullerton soils.

Clarksville cherty silt loam, eroded hilly phase.—The principal differences between Clarksville cherty silt loam, eroded hilly phase, and soil of the hilly phase, previously described, is that the soil of the eroded hilly phase has lost most of its original surface soil, whereas the soil of the hilly phase still retains much or nearly all of its original surface soil. The two soils differ also in their respective ranges in relief, soil of the eroded hilly phase ranging in slope from about 15 to 45 percent, whereas soil of the uneroded hilly phase ranges from about 15 to 30 percent. A few gullies occur in areas of this eroded hilly soil, most of them probably ranging from 2 to 4 feet in depth.

This soil occurs in association chiefly with other Clarksville soils and to less extent with the Fullerton soils. The principal areas are in the vicinity of Kingston and south of Harriman, and smaller areas are scattered over Walker Ridge and east of Paint Rock Creek.

Except in the steeper areas, this eroded hilly soil originally was similar to the uneroded hilly phase of Clarksville cherty silt loam, and it had the same limitations in natural adaptability and the same requirements of management. Owing to the use of this soil for purposes to which it was not adapted, and to improper management, or both, run-off was not adequately controlled, and this resulted in considerable accelerated erosion, which, in turn, decreased the already low productivity, further aggravated the difficult problem of conservation, and somewhat impaired tilth conditions. Practically all of the original organic matter has been lost, chert fragments on the surface have become more abundant, and susceptibility to accelerated erosion has been increased.

Practically all areas of this soil have been cleared at one time or another. At present, it is estimated that about 15 percent is used for pasture, some is still used for orchards, and a very small proportion is being used for the common crops. The greater part is abandoned for crop and pasture use, temporarily at least, and much is reverting to forest. Several of these eroded areas have been used in the past for the production of peaches. Yields of crops, such as corn and small grains, are generally low, and the quality of the pasture is generally low except where the management is good. The idle areas are covered by such plants as broomsedge, cinquefoil, smilax, blackberry, and shoots of oak, persimmon, sassafras, sweetgum, hickory, and pine trees.

Owing largely to low fertility, strong relief, and eroded condition, this soil can hardly be considered suitable for crop production, and it

is not well suited for pasture. Considering its natural adaptability, its most feasible use is forestry. Some areas of this soil may be urgently needed for crops, pasture, or both. Where cropping is necessary, it should be attempted only on the milder slopes, and, if further deterioration is to be prevented, great care in the use and management of the land must be exercised. Only moderate yields are to be expected even under good management.

Clarksville cherty silt loam, steep phase.—Clarksville cherty silt loam, steep phase, resembles Clarksville cherty silt loam, hilly phase, but it differs from that soil in having stronger relief; the slopes of this steep soil in most places are greater than 30 percent. The soil profile resembles that of typical Clarksville cherty silt loam except that the soil layers, especially the surface soil, probably average a little thinner. Considerable variations occur in this soil, and, owing to the impracticability of separating them, small areas of Fullerton cherty silt loam, steep phase, are included in mapping. The chert content is very high in many places—so high that this condition alone would preclude the use of the land for crops.

This soil covers a fairly large total area. It is associated largely with the hilly phase of Clarksville cherty silt loam and to less extent with the other Clarksville soils and also with the Fullerton soils. Rather extensive areas are on Walker, Copper, Chestnut, and Black Oak Ridges, south of Rockwood, and southwest of Kingston.

It is estimated that about 90 percent of the total area occupied by this soil is still in forest. Much of the cleared part now lies idle; some is used for pasture and some for peach orchards. A large proportion of the cleared land is eroded, particularly the part that is or has been in peach orchards. Most of the pasture is of poor quality.

The very strong relief of this soil precludes its use for crops, and although some of it might be used for pasture, its suitability even for this purpose is very low. In addition to the strong relief, the soil is low in natural fertility, cherty, subject to accelerated erosion, and naturally not well adapted to pasture grasses. If used for pasture, careful management will be required, otherwise both the soil and the pasture will deteriorate rapidly. This soil probably is best suited to forestry.

TALBOTT SERIES

Soils of the Talbott series occupy undulating, rolling, and hilly areas in the troughs of the interridge valleys, mainly in association with the Colbert and Dewey soils. The Talbott soils are developed from the residuum of clayey limestones and have grayish-brown surface soils and yellowish-red subsoils. The conspicuous features of the subsoils are their toughness, plasticity, and stickiness. They are well drained externally and fairly well drained internally. In contrast to the Fullerton and Clarksville soils, the Talbott soils have few chert fragments and in many places none. They somewhat resemble the Dewey soils, but they are developed from clayey limestone residuum instead of high-grade limestone residuum, as are the Dewey soils; are more sticky and plastic; have shallower surface soils, subsoils, and substrata; are shallower over bedrock; have a more angular structure in the subsoils; are more susceptible to accelerated erosion; and are injured to greater extent by erosion. Their pro-

ductivity for most of the common crops is lower than that of the Dewey soils. They differ from the Colbert soils, in that they have developed from less clayey limestone, are somewhat deeper over bedrock, are less tough, sticky, and plastic, are better drained internally, are more red and less gray in the subsoils, and have a wider range in adaptability. They are more productive of the commonly grown crops than are the Colbert soils. The reaction is strongly acid. The native vegetation consists mainly of deciduous trees. Limestone outcrops are common.

In uneroded fields, soils of the Talbott series have grayish-brown soft and friable silty clay loam surface soils about 5 to 7 inches thick. The subsoils, ranging in thickness from about 20 to 24 inches, are yellowish-red, tough, sticky, and plastic silty clay that has a fairly well defined angular nutlike structure. The substratum resembles the subsoils but differs primarily in containing numerous yellow, gray, red, and brown mottlings and in having larger structural aggregates. The substratum continues to the uneven floor of the bedrock, which lies at an average depth of about 5 feet below the surface. The bedrock is argillaceous limestone lying in strata that generally have a slight dip.

In this county the Talbott series is represented by one type and two phases, namely, Talbott silty clay loam; Talbott silty clay loam, smooth phase; and Talbott silty clay loam, hilly phase. In addition, two land types include soil materials of this series. Altogether, the soils and land types cover an aggregate of 14,976 acres, or 6.1 percent of the county. About 11 percent of the Talbott soils have undulating relief, 46 percent are rolling, and 43 percent are hilly. Most of the areas have been cleared, and some accelerated erosion has taken place on all such areas. The larger bodies of the Talbott soils are south of Kingston in Riley Creek Valley, east of Kingston in the vicinity of Lawnville, northeast of Kingston in the valley of East Fork Poplar Creek, in the vicinity of the confluence of Poplar Creek and the Clinch River, and in the southeastern part of the county in the vicinities of Dogwood School and Cave Creek. These soils are associated with the Colbert, Dewey, Fullerton, and Clarksville soils and with the miscellaneous land types of rolling stony land (Colbert and Talbott soil materials) and rough stony land (Talbott soil material).

Owing largely to the heavy plastic character of the subsoils, the Talbott soils do not have so wide a range in adaptability as do the Dewey soils, and they are more exacting in their requirements of management. Their suitability for different uses depends largely on their slope and degree of erosion. On the milder slopes, where the soils are not eroded too severely, they can be used for most crops and for pasture. They are not suited to tobacco and truck crops.

Talbott silty clay loam.—Talbott silty clay loam is a heavy-textured soil with rolling relief, the slope ranging from about 8 to 15 percent. It occurs in the troughs of those interridge valleys that are underlain by limestone—by many called limestone valleys. This soil is well drained externally and moderately well drained internally. Normally, the reaction is strongly acid. In most places there are no chert fragments, but limestone fragments are present in some places. Permeability of the soil to air, water, and plant

roots is impaired by the heavy subsoil. Although it is used for crop production, it is not so well adapted for such use as is Dewey silty clay loam.

In uneroded fields Talbott silty clay loam has a 5- to 7-inch mellow grayish-brown silty clay loam surface soil. The content of organic matter in most places is rather low. In wooded areas the topmost inch of soil is stained dark with organic matter. The subsoil consists of yellowish-red silty clay about 20 to 24 inches thick. The conspicuous feature of the subsoil is its tough, tight, plastic, sticky consistence which inhibits aeration, percolation, and penetration by plant roots. The upper part of the subsoil generally is a little lighter in color and a little less sticky and plastic than the lower part. The structure of the material in this layer is angular and nutlike, most of the aggregates being from ½ to 1 inch in diameter. The surfaces of the aggregates are shiny, owing to deposition of colloidal material. A few red, yellow, or gray mottlings are in the lower part of this layer. Below the subsoil the material is mainly reddish yellow profusely mottled with gray, yellow, red, and brown but otherwise similar to the subsoil. This mottled material continues to the uneven bedrock floor, which lies at an average depth of about 5 feet. Bedrock consists of argillaceous limestone lying in strata that generally have a slight dip. Bedrock outcrops are common in areas of Talbott silty clay loam.

Some variations in color, texture, consistence, and depth occur in this soil. A variation, which occurs mainly in the vicinity of Macedonia Church and Lawnville, has a thin covering of water-transported material. The soil of this variation has some water-worn gravel in the surface soil, but the subsoil is similar to that of the typical soil. Accelerated erosion has removed at least one-third of the surface soil from most of the areas. In a few places practically all of the surface soil has been lost.

This is not an extensive soil. It occupies rolling areas in the valleys, underlain by limestone, where it is associated chiefly with other Talbott soils, Colbert soils, rolling stony land (Talbott and Colbert soil materials), rough stony land (Talbott soil material), and to less extent with the Dewey, Fullerton, and Clarksville soils. The size and shape of the individual areas differ greatly. The largest areas are south of Kingston in a belt along the State highway, east of Kingston in the vicinity of Lawnville, northeast of Kingston in the vicinity of the confluence of Poplar Creek and the Clinch River, in the valley of East Fork Poplar Creek, and near Emory.

About 85 percent of this soil has been cleared and used for crops, but a considerable part now is pastured and some is lying idle. The principal crops are corn, small grains, and hay. Lespedeza is the main hay crop. Yields differ greatly, depending largely on moisture conditions. When rainfall is about normal and well distributed throughout the growing season, yields are moderate. The management of this soil has been about the same as that of Dewey silty clay loam and Fullerton cherty silt loam.

The tough, plastic, sticky consistence of the subsoil restricts the adaptability of Talbott silty clay loam. This physical condition inhibits absorption and percolation of water and makes control of runoff and erosion difficult. As most areas of this soil are eroded, tillage

operations turn up at least a part of the upper subsoil layer and the plowed soil is subject to puddling, surface baking, and clodding; and the moisture range under which the land can be successfully tilled is comparatively narrow. Injury to crops from both wet and dry periods is more severe on this soil than on Dewey silty clay loam. Owing largely to its physical condition, Talbott silty clay loam is not so well suited to the production of such crops as corn and small grains as is Dewey silt loam, but it shows less difference in regard to pastures. Alfalfa might grow just as well on Talbott silty clay loam as on Dewey silt loam, but getting a stand would probably be more difficult. Like most of the other soils in this county, Talbott silty clay loam is rather low in lime and other mineral plant nutrients necessary for the normal growth of plants. Response to fertilization is not so great as in the Clarksville, Fullerton, and Dewey soils. In the management of Talbott silty clay loam, emphasis must be placed on careful choice of crops, control of run-off and erosion, maintenance of good tilth, and proper fertilization.

Talbott silty clay loam, smooth phase.—The chief difference between Talbott silty clay loam, smooth phase, and the typical soil is that the smooth soil has gentler relief, the slopes ranging from about 3 to 8 percent. The profile characteristics of the two soils are similar, except that the soil layers are probably a little thicker in soil of the smooth phase and probably less accelerated erosion has taken place on this soil. Variations in color, depth, and other characteristics occur, similar to those in the typical soil. This soil occurs in the same general localities as the typical soil, the larger areas lying along Riley Creek and East Fork Poplar Creek. A very small total area is mapped.

About 90 percent of the land is cleared, and about 40 percent of the cleared land is used for crops, mainly corn, small grains, and some truck crops; about 50 percent for hay and pasture; and about 10 percent is lying idle. During seasons of normal and well-distributed rainfall, acre yields of about 25 bushels of corn, 8 to 10 bushels of wheat, and 1 to 2 tons of hay may be expected.

Because of its milder relief, this soil is more suitable for the production of crops than is the typical soil. Control of run-off and erosion is less difficult, and this allows more flexibility in regard to land management and use. Its adaptation and requirements for management are about the same as for Dewey silty clay loam, but crop yields are probably somewhat lower.

Talbott silty clay loam, hilly phase.—Talbott silty clay loam, hilly phase, differs from typical Talbott silty clay loam chiefly in that it occupies steeper positions. The slope ranges from about 15 to 30 percent, whereas on the typical soil it ranges from about 8 to 15 percent. The profile features are similar for the two soils, except that the hilly soil probably has slightly thinner layers, particularly the surface soil. Variations similar to those included in the typical soil are included in this soil. This soil occurs in the same general localities as the typical soil. The largest areas are in the vicinities of Dogwood School and Cave Creek.

Owing largely to the strong relief, this hilly soil is considerably more susceptible to accelerated erosion than the Talbott soils with milder relief. Many, probably most, of the cleared areas are mod-

erately to severely eroded. Control of run-off and erosion is extremely difficult, and, as stated for the Talbott soils in general, erosion is very injurious to the production of crops. Crops are susceptible to injury from drought on this soil.

It is estimated that at least 60 percent of the total area of this soil has been cleared and used for crop production. Probably about 20 percent is used for the common crops, such as corn and small grains, yields of which are generally low. A considerable part is used for pasture and hay, lespedeza being the chief pasture and hay plant. Some of the pasture is poor, particularly on the severely eroded areas. Much of the land is lying idle or reverting to woods.

Difficult workability, owing to the heavy subsoil, strong relief, occasional outcrops of bedrock, and the difficult problem of control of water and erosion greatly limit the adaptation of this soil, which is not naturally adapted to crops. If crops must be grown, they should be attempted only on the milder slopes and the rotation should be long and include principally close-growing crops. The land is somewhat better adapted to pasture than to crops, but difficulty is experienced in getting good stands of grass, particularly on the most severely eroded areas. Under proper management, including the application of lime and phosphate, pastures would succeed moderately well on this soil. The natural adaptability of this soil is for forest.

Rolling stony land (Colbert and Talbott soil materials).—This land type is commonly referred to as rock land, limestone rock land, or glady land. It is characterized by numerous outcrops of limestone, which cover from 10 to 50 percent of the different areas. The limestone in most places is of the argillaceous type, the kind that normally gives rise to Talbott or Colbert soils. Between the outcrops in most areas is soil material similar to that of either the Talbott or Colbert soils. The surface soil ranges in texture from silt loam to silty clay. Depth to bedrock ranges from a few inches to several feet, and, where the soil material is deep, fairly good Talbottlike soil has developed. In some areas, particularly in association with Colbert silt loam and Colbert silty clay loam, the material between the outcrops consists of brown waxy soil somewhat resembling the Colbert soils. In association with the Upshur soils are some areas in which the outcrops are purplish-red clayey limestones, and the soil material between the outcrops resembles the Upshur soils. Ordinarily, outcrops do not protrude more than a foot above the surface, but some are more prominent. This land ranges from undulating to hilly, but most of it is rolling, with a slope ranging from about 5 to 15 percent. Older citizens point out areas of this stony land that within their memory, have been reduced to their present condition by accelerated erosion.

Areas of this rolling stony land are widely distributed over the county. They occur chiefly in the limestone valleys in association with Talbott and Colbert soils. Large areas are southwest of Kingston in Riley Creek Valley, northeast of Lawnville in Union Valley, along East Fork Poplar Creek, in the vicinity of the confluence of Poplar Creek and the Clinch River, and in the southeastern part of the county in the vicinity of Cave Creek.

The abundance of rock outcrops precludes the use of this land for crops, but most of it is suitable for pasture (pl. 3, *B*). It is esti-

mated that about 60 percent of this land has been cleared, most of which is used for pasture. Its suitability for pasture varies considerably from place to place, owing to differences in depth and character of the soil material and to differences in the proportion of the surface covered by outcrops. Bluegrass does fairly well. It is good in spring, early summer, and late fall, but it provides scant grazing in midsummer and early fall. Some farmers have seeded a part of this land to Bermuda grass for midsummer grazing. The rocky surface does not allow the use of mowing machines in suppressing weeds, and this is a handicap in improvement of the pastures.

Although no chemical data of the soil material of this land are available, it seems to be comparatively fertile and fairly high in most plant nutrients. Much of the soil material is comparatively young, and leaching has been less than on the well-developed soils. Even though the soil material is fertile, productivity is moderate to low because of the undesirable physical properties of the land.

Rough stony land (Talbott soil material).—The chief difference between this land type and rolling stony land (Colbert and Talbott soil materials) is that the rough stony land has stronger relief, most of the slopes being greater than 30 percent. Between the outcrops the Colbertlike soil material is scarce in rough stony land, and the area occupied by limestone outcrops is probably a little greater than on the rolling stony land. These land types also differ in use capabilities, as the rough stony land generally is unsuited to both crops and pasture. Included in this land type as mapped are a few gently sloping areas in which outcrops are very numerous. Also included are a few areas where the outcrops are dolomitic limestone and the soil material between the rocks resembles the Clarksville or Fullerton soils.

This land type is not extensive. Areas occur in positions similar to those of the rolling stony land and have similar geographic associations. Some of the larger areas are in the southern part of the county in Stamp Creek Valley, and in the eastern part in the vicinity of New Zion Church. Narrow areas border the Clinch River.

Owing chiefly to the rough surface, abundance of limestone outcrops, and generally unfavorable physical condition of the soil material, this land should remain in woods.

COLBERT SERIES

Soils of the Colbert series are the heaviest textured soils in the county. They are developed from highly clayey limestones, and, like the Talbott soils, occupy floors of the interridge valleys that are underlain by limestone. External drainage is good in most places, but internal drainage is rather poor, owing chiefly to the heavy plastic and impervious character of the subsoils. In general, the reaction is strongly acid. The native vegetation consists chiefly of deciduous trees, with some cedars. These soils differ from the Talbott soils in that they are developed from the residuum of a more argillaceous limestone, are shallower over bedrock, have tougher, stickier, and more tenacious subsoils, are more poorly drained internally, and have more gray and yellow and less red in the subsoils. Outcrops of limestone are common.

The profiles of the Colbert soils differ considerably in some features, but they all show extremely heavy textured subsoils. In most uneroded areas the surface soils are brownish-gray or olive-gray heavy silt loam or silty clay loam about 5 inches thick. The subsoils are tough, tenacious, sticky, plastic clay or silty clay that is olive yellow mottled with different proportions of red, gray, green, yellow, and brown. The thickness probably averages about 15 inches. In many places this layer rests on the highly argillaceous limestone; elsewhere there is an intervening layer of similar material but more noticeably mottled with gray and green. Flat limestone fragments are common throughout the soil mass, particularly in the lower part.

Soils of the Colbert series are classified in two types and one phase, namely, Colbert silt loam; Colbert silt loam, slope phase; and Colbert silty clay loam. They cover a total area of 9,280 acres, or 3.9 percent of the county. The principal bodies are southwest of Kingston in Riley Creek Valley on both sides of the State highway, east of Kingston in the vicinity of Lawnville, in the southern part of the county in Paint Rock Creek Valley, in the northeastern part in the valley of East Fork Poplar Creek, and in the vicinity of New Bethel Church in Bethel Valley. They are associated chiefly with the Talbott soils, rolling stony land (Colbert and Talbott soil materials), rough stony land (Talbott soil material), and, to less extent, with the Dewey and Fullerton soils.

The Colbert soils, for the most part, are poorly adapted to the production of crops, but they are fairly well adapted to pasture.

Colbert silt loam.—Colbert silt loam has an extremely heavy subsoil and is shallow over bedrock. It occupies smooth or undulating areas on valley floors that are underlain by limestone. The relief is gentle, the slopes ranging from about 2 to 8 percent. External drainage is good in most places, but internal drainage is rather poor. The reaction is acid. Permeability to air, water, and roots is greatly impaired by the heavy subsoil. Limestone outcrops are rather common, and there are many flat limestone fragments throughout the soil mass. This soil is considered fairly suitable for the production of crops, but yields are rather uncertain. The land is difficult to work and difficult to conserve.

In most wooded areas the surface soil is from about 4 to 6 inches thick and in a few places reaches a thickness of 10 inches. It consists of brownish-gray or olive-gray smooth friable heavy silt loam. The topmost inch of soil is stained dark with organic matter. The subsoil is tough, tenacious, tight, sticky, plastic clay or silty clay about 15 inches thick. Olive yellow is the predominant color, with mottling of gray, green, yellow, red, and brown. The structural aggregates, which are angular, jagged, and roughly cubical, increase in size with increase in depth. Aeration, movement of water, and penetration by roots are hampered by this heavy material, which contains a few limestone fragments. Underlying the subsoil is a layer, ranging in thickness from about 4 to 12 inches, of similar material, except that it contains more gray and green mottlings and some decomposing fragments of limestone. This layer rests on the highly clayey limestone, which has weathered into flat slabs in most places.

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Several variations are included in this soil as mapped. There are a few areas in shallow depressions or at the foot of slopes, where drainage is poorer than normal and the soil contains more gray and less brown and red than typical. Some of these areas have a thin deposit of material washed from the adjoining slopes. Also included are a few areas that have a thin covering of what appears to be the remains of old terrace material. In places the subsoil is dominantly red, with yellow, gray, and other mottlings. Depth to bedrock ranges from about 1½ to 3 feet. In some places the bedrock contains shale, and in such areas shale fragments generally are present in the soil.

Colbert silt loam is an inextensive soil. Although it occurs in most of the limestone valleys, the largest areas are southeast of Kingston in Riley Creek Valley on both sides of the State highway, in the southern part of the county in Paint Rock Creek Valley, and in the eastern part in Bethel Valley. This soil is associated with other Colbert soils, the Talbott soils, and the miscellaneous land types—rolling stony land (Colbert and Talbott soil materials) and rough stony land (Talbott soil material).

About 95 percent of the land has been cleared. Approximately 50 percent of the cleared land is now used for crops, chiefly corn, small grains, and hay; about 35 percent for pasture; and 10 percent is lying idle or is abandoned. Yields of crops vary greatly, from year to year, depending to a large extent on the amount and distribution of the rainfall. In favorable years acre yields of 15 to 20 bushels of corn, 8 to 10 bushels of wheat, and 1 ton of hay are reported by many farmers. Crops are highly susceptible to injury from both dry and wet conditions, and under adverse moisture conditions crop yields are correspondingly low. The pastures differ in quality, and many of them are fairly good. Much lespedeza is grown for pasture. The idle land is growing up to redcedar, broomsedge, and other plants of little or no use.

Although this soil has a smooth or gently undulating relief, it presents a difficult problem in regard to workability and conservation, as it erodes readily even on very mild slopes. It is heavy to till, and if tilled under unfavorable moisture conditions it puddles and forms large hard clods. The moisture range under which it can be tilled is narrow, particularly where erosion has been active. Rock outcrops are numerous enough in some areas to interfere with tillage materially. These adverse features, together with ready injury to crops from either wet or dry periods, make this soil poorly adapted to crops. It can be used for the production of crops, but rather exacting requirements for management must be met, particularly in regard to tillage. Owing to limitations imposed by the undesirable physical condition of this soil, response to fertilization may be discouraging, particularly if only small quantities of fertilizers are applied. Alfalfa, clovers, and bluegrass grow well after they are once established, but difficulty is experienced in establishing them. These plants, particularly alfalfa, will not grow successfully on the poorly drained areas. Tobacco and most truck crops are poorly adapted to this soil.

Colbert silt loam, slope phase.—Colbert silt loam, slope phase, differs from typical Colbert silt loam, chiefly in having stronger

relief. The slope ranges from about 8 to 15 percent, whereas that of the typical soil ranges from about 2 to 8 percent. In addition, depth to bedrock is probably less, and limestone outcrops are more numerous, compared with those features of the typical soil. Variations similar to those included in typical Colbert silt loam are included also with this soil.

This is not an extensive soil. It is associated with the same soils and miscellaneous land types as the typical soil, in about the same general sections of the county.

About 40 percent of this soil has been cleared and once cultivated, the rest remaining in woods; but less than 20 percent now is cultivated. Of the remaining cleared land, much is being used for pasture and some is lying idle, a part of which is reverting to woods. Redcedar is generally abundant on these areas. The pastures differ in quality, depending largely on management practiced. Yields of such crops as corn, small grains, and tobacco are generally low unless weather conditions are nearly ideal throughout the growing season. Lespedeza is probably one of the most consistent producers on this soil.

The significance of the unfavorable physical condition of typical Colbert silt loam also applies to soil of the slope phase. The problems pertaining to conservation and workability are further intensified by the more pronounced relief. Most of this soil, therefore, is not considered suitable for the production of crops, particularly intertilled crops, but with good management it produces fair to good pastures.

Colbert silty clay loam.—Colbert silty clay loam resembles Colbert silt loam but differs from that soil chiefly in having a shallower and heavier textured surface soil. The subsoil is probably a little more tough, sticky, and plastic, but otherwise it is similar to that of the other Colbert soil. Depth to bedrock is about the same in the two soils, but the bedrock underlying the silty clay loam is probably a little higher in argillaceous material than that underlying the silt loam. Colbert silty clay loam has a light-brown smooth and fairly friable silty clay loam surface soil about 2 to 4 inches thick. The subsoil is tight, tough, tenacious, plastic, sticky clay or silty clay, mainly olive yellow, mottled with gray, green, yellow, red, and brown, the gray and green mottlings increasing with depth. Depth to bedrock is from 2 to 4 feet, and flat limestone fragments are common throughout the soil. Although the slopes range from about 2 to 15 percent, most of them are less than 6 percent.

A variation included with this soil as mapped is a soil with similar consistence and depth but having a mottled red subsoil. Such areas occur chiefly in the valley of East Fork Poplar Creek. Included also, near South Harriman, is a soil that has developed from residuum of interbedded limestone and shale. In a few scattered areas the surface soil reaches a thickness of 8 inches. Also included are areas of soil transitional in character to the Talbott and Armuchee soils. The surface soil has been removed by accelerated erosion in many of the cleared areas.

This is the most extensive member of the Colbert series. It is widely distributed over the limestone valley section. Large areas are southwest of Kingston in Riley Creek Valley on both sides of

the State highway, east of Kingston in the vicinity of Lawnville, northeast of Kingston in the valley of East Fork Poplar Creek, and in the southern part of the county in Paint Rock Creek Valley. This soil is associated chiefly with the Talbott soils and other Colbert soils, also with rolling stony land (Colbert and Talbott soil materials) and rough stony land (Talbott soil material).

It is estimated that about 40 percent of this soil has been cleared and cultivated, but that less than 20 percent is now used for crops. A considerable part is used for pasture, some is lying idle, and some is reverting to woods.

Owing to the fact that the physical condition of this soil is somewhat poorer than that of Colbert silt loam, Colbert silty clay loam can hardly be considered suitable for crop production, but with reasonably good management it supports fair to good pasture.

UPSHUR SERIES

In Roane County, soils of the Upshur series are characterized by their purple color, heavy texture, shallowness over bedrock, and neutral or slightly alkaline reaction. They are derived from purplish-red highly argillaceous or shaly limestones. In structure and consistence they resemble the Talbott soils but differ from them sharply in color. They have rolling relief, are well drained externally and fairly well drained internally, are neutral to medium alkaline in reaction, and in many places contain limestone fragments. Although they are not extensive, they are conspicuous. They occur in narrow elongated strips in valleys in association chiefly with the Clarksville and Talbott soils. Only one phase of the Upshur series is mapped in this county—Upshur silty clay loam, valley phase.

Upshur silty clay loam, valley phase.—Upshur silty clay loam, valley phase, has a 3- to 5-inch purplish-brown friable silty clay loam surface soil. The subsoil consists of purplish-red or purplish-brown tight, sticky, plastic clay or silty clay, about 18 to 22 inches thick. This layer normally rests on partly disintegrated purplish-red shaly limestone. In many places the soil effervesces with acid from the surface down, indicating a high content of lime. Surface drainage is good, but internal drainage is somewhat retarded. This soil is highly susceptible to accelerated erosion, as the relief is prevailingly rolling, the slope ranging from about 8 to 15 percent. Limestone outcrops in many areas.

This soil covers a small total area. It occupies conspicuous narrow strips, ranging in width from about 100 to 800 feet, on the lower valley slopes. The common position is between the higher lying Clarksville soils and lower lying Colbert soils. The Upshur soil occurs in the southern and eastern parts of the county in Bethel, Buck Creek, and Paint Rock Valleys.

Practically all of this soil has been cleared and at one time or another has been cultivated. Some accelerated erosion has taken place in most areas. Some areas are still used for the production of crops such as corn and small grains, but most of the land is in pasture. Crops yield well on this soil, but, owing largely to its heavy consistence, the soil is very difficult to conserve and to till. In addition it is shallow over bedrock. For these reasons this soil is not considered suitable for crop use, but it is admirably suited to

pasture. Bluegrass and a number of clovers grow luxuriantly, and alfalfa should succeed. This soil does not need lime.

ARMUCHEE SERIES

The soils of the Armuchee series are derived from materials weathered from residuum of interbedded limestone and shale. They are variable in profile characteristics, depending largely on the proportions of limestone and shale in the bedrock; but generally they are shallow. These soils are associated with the soils derived from sandstone and acid shale residuum on one side and those derived from limestone residuum on the other. They are well drained, have an acid reaction, and contain some shale fragments. Only one soil type, Armuchee silt loam, is mapped.

Armuchee silt loam.—This soil has undergone little development and varies somewhat from place to place. In most places it has a 2- or 3-inch gray surface layer underlain by a 6- to 12-inch yellowish-brown or brownish-yellow silt loam or silty clay loam layer. In most places this rests on material that consists largely of soft shale fragments, and tiny shale fragments are distributed generally throughout the soil. Where the proportion of limestone to shale is high, the soil is deeper, is heavier textured in the lower part, and in many places has a red cast. The relief is hilly and steep, the slope ranging from about 15 to probably 50 percent, with the steeper slopes predominating.

Rather wide variations are included in this soil as mapped. Some of the areas have limestone outcrops; in some areas the depth of the soil material over shale is only a few inches, and in others it is more than 20 inches; and in some areas sandstone is present in the parent rock and also in the soil material. A few areas of Apison and Muskingum soils are probably included.

It is estimated that about 25 percent of this soil has been cleared and at one time or another used for crops, although now little of it is so used, but much of the cleared land is used for pasture. The Armuchee soils are not adapted to crops, owing largely to their strong relief, susceptibility to erosion, and shallowness over bedrock. As typically developed, the Armuchee soil may be used for pasture, and where lime and phosphate are applied, fairly good pastures are obtained. Owing to the inclusion of extensive variations of inferior productivity, however, most areas of this soil are not considered suitable for pasture and should remain in forest.

APISON SERIES

Soils of the Apison series are derived from interbedded shale and sandstone, the shale decidedly predominating, and they occur chiefly in those interridge valleys that are underlain in part by these rocks. These soils are well drained, shallow over bedrock, strongly acid in reaction, comparatively low in natural fertility, low in organic matter, and highly susceptible to accelerated erosion. They are associated chiefly with the Lehew and Muskingum soils. Where uneroded, they have brownish-gray or yellowish-gray surface soils and brownish-yellow subsoils. Shale fragments generally are numerous in the soil mass, particularly in the subsoils. Depth to bedrock is

about 2 to 3 feet. The adaptability of these soils to crops depends largely on the degree of erosion and slope. Where uneroded, they are adapted to the production of most of the crops commonly grown. The soils of the Apison series are classified in one type and two phases; namely, Apison very fine sandy loam; Apison very fine sandy loam, eroded phase; and Apison very fine sandy loam, eroded slope phase. In addition, rough gullied land (Apison soil material) is mapped. The typical soil and the eroded phase are not extensive, but the eroded slope phase is extensive. Altogether, the soils and land type cover an area of 14,336 acres, or about 5.8 percent of the county.

Apison very fine sandy loam.—Apison very fine sandy loam is not an extensive soil and is not of much agricultural importance. It is well drained, strongly acid in reaction, and comparatively low in natural fertility. It is from 2 to 3 feet thick over bedrock, which consists of interbedded acid shale and sandstone, the shale predominating. This soil has gentle relief, the slopes ranging from about 2 to 7 percent, with a few slopes as steep as 15 percent.

In uneroded fields this soil has an 8- to 10-inch brownish-gray or yellowish-gray loose and open fine sandy loam surface soil. The subsoil consists of brownish-yellow friable very fine sandy clay ranging in thickness from about 14 to 24 inches. It is splotched, particularly in the lower part, with yellow, gray, and brown. Most of these splotches apparently are caused by disintegrating shale fragments rather than inadequate drainage, which probably accounts for some of them. The subsoil rests on partly weathered shale and sandstone, with shale greatly predominating. In most places the rock strata have a very pronounced dip and the material is varicolored, including different shades of yellow, brown, and light purple. In most areas a few small sandstone fragments and numerous shale fragments are distributed throughout the soil mass and over the surface. Small areas of Jefferson soils are included with this soil as mapped, where separation of the Jefferson soils was considered impracticable.

Apison very fine sandy loam occurs in small areas, few of which exceed 30 acres. It is associated chiefly with the other Apison soils and to less extent with the Lehew and Muskingum soils. Some of the larger areas are near Johnson, near Macedonia Church, and southwest and northwest of Wheat.

About 80 percent of this soil has been cleared and put under cultivation. Probably about 20 percent still produces crops, such as corn, small grains, and truck crops, and about 60 percent is used for pasture and hay crops. Yields of crops are fair to low; frequently reported yields of corn range from 15 to 20 bushels an acre. Lespedeza is the chief hay and pasture crop.

Although the natural fertility of Apison very fine sandy loam is comparatively low, it has good tilth and responds well to fertilization. Under good management it produces moderate to good yields of corn, small grains, truck crops, and lespedeza. As it is low in lime, organic matter, and presumably in phosphate, applications of these should be made. Every precaution should be taken to control run-off and thereby prevent accelerated erosion, because this soil is highly susceptible to severe erosion. Long rotations dominated by close-growing crops are necessary for the prevention of erosion.

Apison very fine sandy loam, eroded phase.—Apison very fine sandy loam, eroded phase, differs from the typical soil in that considerable accelerated erosion has taken place. As a result of erosion this soil is very shallow over the shale bedrock, which lies from 3 to 12 inches below the surface. Considerable shale is generally present in the soil material. The relief is gently undulating, the slopes ranging from about 2 to 8 percent. Surface run-off is great, owing to the shallowness of soil material over the shale. This eroded soil occurs in the same general localities as the typical uneroded soil.

Only a very small area is mapped. Practically all of the land has been cleared and used for the production of crops in the past, but at present the greater part is abandoned, although some is used for pasture and a little for crops. The productivity, use capabilities, and requirements for management are about the same as for Apison very fine sandy loam, eroded slope phase.

Apison very fine sandy loam, eroded slope phase.—Apison very fine sandy loam, eroded slope phase, is among the more extensive soils in this county. This soil differs from typical Apison very fine sandy loam in that it is eroded and has stronger relief. In degree of erosion it corresponds to Apison very fine sandy loam, eroded phase, but differs from that soil in having stronger relief. Erosion has removed practically all of the original surface soil and in many places most of the original subsoil. Consequently, the depth to bedrock is slight, in most places ranging from 3 to 12 inches. A few shallow gullies occur in many of the areas.

Where this soil is about 12 inches deep, the surface soil is yellowish gray very fine sandy loam, and the subsoil is rather firm but friable clay loam or very fine sandy clay. The subsoil rests on the partly weathered varicolored noncalcareous shale. Differences in the color of the soil material are associated with differences in the color of the shale. The principal colors of the shale are various shades of yellow, gray, brown, red, and purple, and the principal colors of the soil are shades of gray and yellow and, in many places, light shades of brown, red, and purple. The texture of the soil material ranges from silt loam to very fine sandy loam, depending on the proportion of sandy material in the parent rock. In the vicinity of Wheat, the soil in some areas is developed from purple noncalcareous nonsandy shale. In such areas the soil material is deeper, heavier textured, and more purple than normal.

This soil occurs chiefly in the smaller interridge valleys in geographic association with the Lehew and Muskingum soils, but it is also associated with soils of the terrace lands, colluvial lands, and bottom lands. Extensive areas are in most of the valleys in the southern and eastern parts of the county, particularly in Stamp Creek, Dry Fork Creek, Paint Rock, May, Buttermilk, and White Creek Valleys. Areas are also in the eastern part between Mary Crabtree School and Luminary Church, near Phillips Chapel, and in Pinchback and Margrave Valleys. Many of the areas are rather large.

Practically all of this soil has been cleared and used for the production of crops, but comparatively few areas are still in cultivation. Some are used for pasture. Crop yields are low and uncertain, and most of the pastures are of poor quality. A large proportion of the total area is now lying idle or has been abandoned. The idle and

abandoned land is growing up to broomsedge and brush. Conditions resulting from erosion make this soil poorly adapted to crops or pasture. Owing to its extreme shallowness, it has very low moisture-holding capacity, and crops quickly suffer from adverse moisture conditions. In addition, it is low in lime, organic matter, and presumably in phosphate. This soil is probably best suited to forestry, although a few farmers, who have recently applied lime and phosphate to this soil, have obtained rather encouraging results, as fair hay crops of lespedeza and certain grasses have been grown as well as pastures of reasonably good quality. Probably under careful management this soil could be brought back to and maintained at a fair level of productivity for pastures and some crops.

Rough gullied land (Apison soil material).—Erosion has acted on this land type in much the same way as on rough gullied land (Fullerton soil material). The soil of both land types is practically destroyed by a network of gullies. The important difference between the two land types is that depth to bedrock in the Fullerton land type in most places is 20 feet or more, whereas in the Apison land type it is only a few inches, or the bedrock itself is exposed. The Apison soil material is largely residual from shale, whereas the Fullerton soil material is residual from dolomitic limestone. Some rough gullied areas of Lehew soil material and Muskingum soil material are included with this land type as mapped. This land has a wide range in relief, but most of it is rolling, with slopes ranging from about 10 to 20 percent.

This rough gullied land covers a very small total area. Most of the bodies are scattered over the valleys where the Apison soils are mapped. The land should be used only for forestry.

LEHEW SERIES

Like the Muskingum soils, the Lehew soils are shallow, stony, strongly acid, excessively drained, and derived from acid shale and sandstone and have a steep and hilly relief. They differ from the Muskingum soils chiefly in coming from residuum of varicolored shale and sandstone in which purple, purplish red, and purplish gray are the dominant colors, and in having tints of purple throughout the soil mass. The Lehew soils occupy several ridges in the great valley section of the county, where they are associated with the Muskingum and Hector soils. They do not occur on the Cumberland escarpment or on the Cumberland Plateau. Only one type is mapped, Lehew stony fine sandy loam.

Lehew stony fine sandy loam.—A distinctive feature of Lehew stony fine sandy loam is its purple color. Like Muskingum stony fine sandy loam, Lehew stony fine sandy loam is somewhat variable in soil characteristics. Probably in most of the areas the 6- to 8-inch surface soil is purplish-gray loose fine sandy loam overlying an 8- to 14-inch subsoil layer of purplish-yellow or purplish-brown friable fine sandy clay. In many places the subsoil rests directly on the shale and sandstone bedrock, but, where it does not, the intervening layer consists of friable fine sandy clay and ranges in thickness from a few inches to a foot. The color is a mixture of purplish red, reddish purple, purplish gray, yellow, green, and gray. This variegation probably is caused by disintegrating shale fragments

Hillside of Lehew stony fine sandy loam that apparently has been cleared, tilled, and later
The trees on the ground have recently been cut in thinning the stand—a gooc

and not by poor internal drainage. The underlying rock is a mixture of varicolored shale and sandstone, in which shades of purple and yellow predominate. The dip of the rock strata is nearly perpendicular in many places.

Different quantities of sandstone and shale fragments are scattered over the surface and throughout the soil mass. Drainage is excessive. This soil is strongly acid in reaction, has low water-holding capacity, and is low in natural fertility. The relief is hilly and steep, the slope ranging from about 15 to 50 percent—in most places from 20 to 40 percent.

As previously stated, considerable variations occur in this soil. One intricately associated variation consists of a yellow or grayish-yellow but otherwise similar soil. Numerous areas mapped as Lehew stony fine sandy loam in this county may be considered a complex. In some areas the soil comes chiefly from shale residuum, and in these areas the soil is shallow, generally not more than 8 to 10 inches thick. Also included are small areas of other soils having a correspondingly strong relief, especially the Hector and Muskingum soils.

Lehew stony fine sandy loam is the second most extensive soil in the county. It occurs in rather large and unbroken belts on the sandstone and shale ridges, where it is associated chiefly with the Muskingum and Hector soils. Large areas are on River, Hurricane, Stamp Creek, Dug, and the several Pine Ridges, also in the vicinities of Laurel Bluff and Ponder Church and northwest of Mary Crabtree School.

About 20 percent of this land has been cleared and has been used at one time for the production of the commonly grown crops. Today most of the land either is abandoned or is used for pasture, most of which is of poor quality. Owing to the strong relief, stony condition, shallowness over bedrock, low moisture-holding capacity, and strongly acid reaction, this soil is considered unfit for the production of crops and very poorly adapted to pasture, although it is probably a little better adapted to this purpose than the associated Muskingum soils. Where lime and phosphate have been applied, moderately good pastures have been obtained. This soil, however, is naturally best adapted to forest (pl. 4). Pine trees are numerous on most of the wooded areas.

MUSKINGUM SERIES

Most of the soils of the Muskingum series in Roane County are stony, have hilly and steep relief, and are developed from the residuum of sandstone and shale. They are brownish yellow or grayish yellow, shallow over bedrock, excessively drained, and strongly acid in reaction. They are chiefly associated with the Lehew, Hector, and Hartsells soils. The Muskingum soils are extensive. They are widely distributed on the Cumberland Plateau, on the Cumberland escarpment, and on the shale and sandstone ridges of the great valley.

Muskingum stony fine sandy loam.—Muskingum stony fine sandy loam varies somewhat from place to place, but it is prevailingly light colored, strongly acid in reaction, stony and shaly, and shallow over bedrock. It has a pronounced relief. Probably, in most of the areas, the surface soil ranges in thickness from 10 to 14 inches and consists of grayish-yellow loose and open fine sandy loam. In wooded areas the

topmost 1- or 2-inch layer is stained dark with organic matter. The subsoil consists of brownish-yellow friable fine sandy clay and ranges in thickness from 10 to 20 inches. This layer rests on broken sandstone and shale. More or less shale and sandstone are distributed throughout the soil.

The slope ranges from 15 to 60 percent or probably more. In most places, it ranges from 20 to 40 percent. Areas on the Cumberland escarpment, in particular, are very steep, and here bedrock outcrops in many places.

A rather extensive variation included with this soil in mapping consists of areas where the soil is developed chiefly from acid shale. In these areas the soil is very shallow, generally less than a foot thick, and contains many shale fragments. This variation closely resembles the Montevallo soils mapped elsewhere in eastern Tennessee. A variation near the foot of the Cumberland escarpment includes a soil formed from residuum of sandy dolomitic limestone. This inclusion somewhat resembles Clarksville cherty silt loam, steep phase, and Fullerton cherty silt loam, steep phase, but differs from those soils in that it is sandy. Also included are areas of Hector stony fine sandy loam and Lehew stony fine sandy loam that are too small to map separately.

Muskingum stony fine sandy loam is the most extensive soil in the county. It is associated chiefly with the Hartsells, Lehew, Hector, Apison, and Jefferson soils. The Muskingum soil is widely distributed over the county, occurring on the sandy and shaly ridges, on the Cumberland escarpment, and on the Cumberland Plateau.

Only a small proportion of the land has been cleared. It is not adapted to the production of crops, owing largely to the strong relief, stony condition, shallowness over bedrock and poverty in essential plant nutrients. Neither is it naturally adapted to pasture, but some areas are used for that purpose. If lime and phosphate were applied, moderately good pastures could probably be obtained. The best use for this soil is forestry.

Rough stony land (Muskingum soil material).—This land type, which is fairly extensive, is restricted almost entirely to the steep and extremely rocky slopes of the Cumberland escarpment, where it is the dominant land type, although some areas are in the Cumberland Plateau section of the county.

The soil material filling the spaces between the rocks is essentially Muskingum stony fine sandy loam. The rocks consist of rather fine grained sandstones, quartzites, and sandstone conglomerates in the form of outcrops and loose boulders.

Practically all of this land is in forest, in which deciduous trees, including several species of oak, hickory, and dogwood, together with a few redcedars and pines, are the dominant trees. The land is best adapted to forestry.

HECTOR SERIES

The Hector soils are derived chiefly from sandstone residuum. Like the Muskingum and Lehew soils, these soils are stony, have hilly and steep relief, are excessively drained, and are strongly acid in reaction; but they are somewhat deeper over bedrock and apparently have undergone a little more development. The Hector soils

are distinctive in that they are red, reddish brown, or brownish red in the subsoil. Only one type of the Hector series is mapped, Hector stony fine sandy loam.

Hector stony fine sandy loam.—Hector stony fine sandy loam varies considerably from place to place, but it is distinguished everywhere by its red subsoil. Probably in most areas the 8- to 12-inch surface soil consists of grayish-brown or brownish-gray loose fine sandy loam; and the subsoil, ranging in thickness from 15 to 25 inches, consists of yellowish-red, reddish-brown, brownish-red, or dark-red friable very fine sandy clay or clay loam. In some places the subsoil rests on the sandstone bedrock; but where it does not, the intervening layer consists of fine sandy clay or clay loam that is generally some shade of red mottled with gray, yellow, and brown. Depth to bedrock in most places is between 3 and 6 feet, but in many places it is less. Sandstone outcrops are common in many areas. Bedrock consists chiefly of sandstone with a little shale mixed with it, but in some places the proportion of shale is rather high.

In most areas some sandstone fragments are distributed throughout the soil and over the surface, but the number of sandstone fragments differs from place to place, in some places being few, in others numerous. A few areas in which the sandstone is slightly calcareous are included. Such areas occur chiefly on Welcer, Bacon, and Riley Ridges. The relief is hilly and steep, the slope ranging from slightly less than 15 percent in a few places to probably more than 50 percent in others. Included in areas mapped as this soil are small areas of other soils with similar relief, especially Muskingum and Hector soils.

Hector stony fine sandy loam occupies a fairly large total area. It is associated chiefly with the Lehew and Muskingum soils and to less extent with the Hartsells and Allen soils. Although areas of this soil in nearly all sections are underlain by sandstone and shale, the main areas are in the southern part of the county, on Riley, Bacon, and Welcer Ridges, where this soil predominates over the other soils.

It is estimated that probably 20 percent of the total area of this soil has, at one time, been cleared and used for crops. It is not, however, well adapted to crops, although it is somewhat more productive than the Lehew and Muskingum soils. Gently sloping areas that are nearly free from stones can probably be used for crops if good management is practiced; but such areas are few. Some of the cleared land is used for pasture and some is lying idle and reverting to woods. This soil is probably better suited for pasture than the Lehew and Muskingum soils; but even so, its suitability is low. Owing largely to its stoniness, strong relief, and comparatively slight depth over bedrock, this soil is best adapted to forestry.

HARTSELLS SERIES

Soils of the Hartsells series are developed chiefly from weathered sandstone and occupy the undulating remnants of the Cumberland Plateau. The surface soils are yellowish gray, and the subsoils are yellow. Depth to bedrock, which is horizontally bedded, is about 3 to 4 feet. These soils are strongly acid in reaction, rather low in content of organic matter and mineral plant nutrients, and mod-

erate to low in moisture-holding capacity; but they have gentle relief and excellent tilth. Soils of this series in Roane County are classified in one type and one phase, namely, Hartsells very fine sandy loam and Hartsells very fine sandy loam, slope phase. These soils are not extensive.

Hartsells very fine sandy loam.—In the virgin condition, Hartsells very fine sandy loam has a 7- to 9-inch surface soil consisting of yellowish-gray or brownish-gray loose and open very fine sandy loam. The topmost 1- or 2-inch layer is stained dark with organic matter. The subsoil consists of yellow, brownish-yellow, or reddish-yellow friable and crumbly very fine sandy clay or clay loam, which ranges in thickness from about 16 to 24 inches. This layer contains a few red and brown mottlings, apparently due to decomposing sandstone fragments rather than to imperfect drainage. The material below the subsoil is variable, in many places being high in sandstone fragments and mottled with yellow, red, gray, and brown. This layer, which rests on the bedrock, is variable in thickness but in most places is not more than 1 foot thick. The bedrock consists chiefly of light-colored sandstone, with a comparatively small proportion of shale. The rock strata lie horizontally.

This soil has a gently undulating relief, the slope ranging from about 2 to 7 percent. It is strongly acid in reaction, is comparatively low in organic matter and mineral plant nutrients, and has only a moderate moisture-holding capacity; but it is well drained, has favorable relief and excellent tilth, and is highly responsive to fertilization.

Hartsells very fine sandy loam is not extensive. Areas are on the undissected remnants of the Cumberland Plateau—the physiographic region, of which the Cumberland escarpment marks the eastern boundary. Most of the areas lie along the northwestern boundary of the county, between Rockwood and Harriman. This soil is associated chiefly with the slope phase of Hartsells very fine sandy loam and with Muskingum stony fine sandy loam.

This soil lies at an elevation ranging from 700 to 800 feet higher than the great valley section of the county, in which most of the other soils lie; and this higher elevation changes the climate somewhat. As compared with the climate in the great valley section, the Cumberland Plateau section has about 20 percent heavier mean summer rainfall, about 5° lower mean summer temperature, and a shorter average frost-free period by about 27 days.

Most of the areas of this soil are cleared and are used for the production of crops. Those areas still uncleared are more or less isolated by the steeply sloping uncropped Muskingum soils. Corn, wheat, oats, sorghum, potatoes, and hay are grown on the Hartsells soil. With reasonably good management, acre yields ranging from 25 to 30 bushels of corn, 1 to 1½ tons of hay, and 100 to 125 bushels of potatoes are obtained.

This soil is low in mineral plant nutrients, low in lime, and rather shallow over bedrock, and these qualities detract from its agricultural value. On the other hand, it is well drained, has excellent tilth, is responsive to fertilization, and occurs under very favorable climatic conditions, which enhance its agricultural value. This soil is considered particularly well suited to the production of potatoes

and other root crops adapted to the climate. A number of truck crops also are well adapted to this soil. Owing to its gentle relief, this soil is not highly susceptible to accelerated erosion, but any degree of erosion is harmful, and the management and use should be such as to prevent erosion.

Hartsells very fine sandy loam, slope phase.—Hartsells very fine sandy loam, slope phase, is more extensive than the typical soil, although its total area is small. This soil differs from the typical soil chiefly in relief, the slope ranging about 7 to 15 percent. Associated with this more pronounced relief is a somewhat slighter depth to bedrock and greater variation in depth to bedrock. In most areas bedrock lies from 18 to 30 inches below the surface, although in some places it outcrops and sandstones are on the surface and throughout the soil. Otherwise these two soils are similar. Included with soil of the slope phase, however, are small areas in which the subsoil is red.

This soil occurs on the Cumberland Plateau on the divides between creeks and drains. Many of the areas are elongated and rather narrow and are flanked by the steeply sloping uncropped Muskingum or Hector soils or rough stony land (Muskingum soil material). The fact that many areas are nearly isolated by these steeply sloping uncropped soils partly accounts for the comparatively large proportion still in forest. This sloping soil is associated also with typical Hartsells very fine sandy loam.

About 25 percent of the total area occupied by this soil is cleared and is used for the production of crops, such as corn, wheat, barley, hay, and potatoes, and a small proportion is used for pasture. Yields are generally lower than on the typical soil. The yields vary, depending largely on the depth of soil over bedrock. Reported acre yields of corn are from 15 to 20 bushels; wheat, 8 to 10 bushels; barley, 25 bushels; and hay, ¾ to 1 ton. The trees in the wooded areas are mainly oaks—post, southern red, and scarlet—together with some pines.

Owing to its stronger relief and slighter depth over bedrock, this soil is not so well adapted to crops as is typical Hartsells very fine sandy loam, although fertilizer requirements of the two soils are similar and good responses can be expected from fertilization on this soil. Where the depth to bedrock is shallow, the water-holding capacity of this soil is low and crops suffer rather quickly from lack of moisture. In the use and management of this soil, strict attention must be given to the prevention of accelerated erosion, because it is susceptible to erosion, and as this continues, the depth to bedrock decreases, which seriously impairs the value of the soil for agriculture.

MINE DUMPS

The material included in the land classified as mine dumps consists of refuse from mines, chiefly slaty material from the coal mines. Most of the areas of this land are in the Cumberland Plateau section, where the coal mines are located, although some of the areas are on Welcer Ridge between 3 and 4 miles south of Kingston. The material in the latter areas consists of dump and refuse from some old iron mines. The total area covered by mine dumps is small, and the land is practically worthless for agriculture.

SOILS OF THE COLLUVIAL LANDS

The so-called colluvial lands might be more properly designated as local colluvial lands. They are really a combination of local alluvium and colluvium. Such accumulations have taken place at the foot of slopes, particularly the longer slopes, where geologic erosion has been active. Many of the areas are alluvial fans or cones, particularly where the Leadvale and Greendale soils occur. Most of the soils of these colluvial lands are young and have not undergone so much development as soils of the Dewey and Fullerton series of the uplands, although many of them have developed color profiles normal to the region as a whole. In Roane County, all these soils are friable, are fairly well to very well drained, are acid in reaction, have a mild relief, and are prevailingly either yellow or red. Soils of this group are not extensive, covering only 13,696 acres, or about 6 percent of the county, but they are important agriculturally. Although they differ in productivity, they all are adapted to the production of a wide range of crops.

The soils of these colluvial lands are classified in four series, namely, Allen, Jefferson, Leadvale, and Greendale. The material giving rise to the Allen and Jefferson soils originated from sandstone, that giving rise to the Leadvale soils from shale, and that giving rise to the Greendale from dolomitic limestone. The Allen soils have grayish-brown surface soils and brownish-red subsoils; the Jefferson soils have grayish-yellow surface soils and brownish-yellow subsoils; the Leadvale soils have brownish-gray surface soils and yellow slightly mottled subsoils; and the Greendale soils have light grayish-brown surface soils and yellow subsoils.

ALLEN SERIES

The parent material of the Allen soils is derived chiefly from sandstone rocks and from soils developed from sandstone residuum, chiefly the Lehew, Muskingum, and Hector soils. The material has accumulated at the foot of ridge slopes in the form of colluvial and alluvial fans and cones. The thickness of the accumulated material in most places is more than 3 feet. These soils occur chiefly at the foot of the Cumberland escarpment. They have grayish-brown surface soils about 8 inches thick and brownish-red subsoils about 25 inches thick. In most places a few sandstones are scattered over the surface and throughout the soil mass. These soils are well drained, have gently sloping or strongly sloping relief, are strongly acid in reaction, have good tilth, and are moderately well adapted to and moderately productive of the commonly grown crops. One type and one phase are mapped—Allen very fine sandy loam, and Allen very fine sandy loam, slope phase. They cover a total area of 6,912 acres, or 2.9 percent of the county.

Allen very fine sandy loam.—Allen very fine sandy loam is friable, well drained, easily penetrable by air, water, and roots, and strongly acid in reaction; it has good tilth and is moderately productive. There are a few sandstone fragments on the surface and throughout the soil mass. This soil has gently undulating relief, the slope ranging from 2 to 8 percent.

In uneroded fields this soil has a 6- to 10-inch grayish-brown mellow very fine sandy loam surface soil containing a moderate supply of organic matter. The subsoil, which ranges in thickness from 20 to 30 inches, consists of red, brownish-red, reddish-brown, or yellowish-red friable very fine sandy clay. The material below the subsoil is variable, depending on the depth of the accumulated material, but generally it is mottled with red, gray, yellow, and brown, is sandy in texture, and contains numerous sandstone fragments, many of which are in the process of disintegration.

This soil contains a significant quantity of sandstone gravel, cobbles, and stones, both on the surface and throughout the soil mass. In some areas accelerated erosion has removed much of the surface soil. In a few areas the surface soil is darker brown than is typical for Allen soils. In some areas, chiefly on the lower slopes on the southeastern side of Welcer, Bacon, and Riley Ridges, some of the source material consists of calcareous sandstone, and here the soil is a little more productive than normal.

Allen very fine sandy loam covers a very small total area. Although it occurs at the foot of many of the shale and sandstone ridges, it lies chiefly at the foot of the Cumberland escarpment. It is associated mainly with Allen very fine sandy loam, slope phase, but also with the Hector, Muskingum, and Lehew soils and with rough stony land (Muskingum soil material). It is also associated with soils of the terrace lands and bottom lands.

Nearly all of Allen very fine sandy loam has been cleared and is used for agriculture. Probably about one-half is used for cultivated crops, nearly one-half is used for hay and pasture, and a very small proportion is in woods or lies idle. The crops grown include corn, small grains, and truck and fruit crops. Yields are moderate.

This soil has many desirable qualities. It has good tilth, favorable relief, and a moderate content of organic matter. It is not highly susceptible to erosion or readily injured by erosion. On the other hand, it is generally low in lime and other mineral plant nutrients and has only moderate natural fertility. It is adapted to the production of a great number of different crops, including corn, wheat, oats, barley, lespedeza, various clovers, alfalfa, bluegrass, orchard grass, timothy, various truck and fruit crops, and tobacco. Lime and some phosphate are required for clovers, alfalfa, and bluegrass to grow successfully. Although the natural fertility of this soil is only moderate, it responds to good management and produces fairly high yields of the common crops.

Allen very fine sandy loam, slope phase.—Allen very fine sandy loam, slope phase, is much more extensive than typical Allen very fine sandy loam. The slope phase differs from typical Allen very fine sandy loam chiefly in relief, as the slope ranges from about 7 to 15 percent. Erosion is more active on this soil than on the typical soil, and many of the areas contain considerable quantities of quartz and sandstone gravel, in addition to sandstone cobbles and stones. Included are variations similar to those included with typical Allen very fine sandy loam. Owing chiefly to its greater slope, this soil is less desirable for agriculture than the typical soil.

Extensive areas of this sloping soil are at the foot of the Cumberland escarpment and on the southwest lower slopes of Welcer, Bacon, and Riley Ridges. Typically, the Hector and Muskingum soils occupy the adjoining higher steep slopes, and soils of the terrace lands and bottom lands occupy the adjoining lower level or mildly sloping areas. Some areas are associated with the Jefferson soils, which occupy similar positions.

It is estimated that about 85 percent of the total area of this soil is cleared. Probably about 20 percent, chiefly the steeper part, is growing up in bushes, weeds, and broomsedge. About 25 percent is used for crops, such as corn, small grains, truck, and fruit, yields of which are somewhat lower than on the typical soil. About 40 percent is used for pasture and hay, lespedeza being one of the chief pasture and hay plants.

Yields of crops on this soil are not high, but the possibilities of increasing the yields are very good. Although the soil is comparatively low in content of mineral plant nutrients, it has good physical condition and good tilth and responds to good management. As this soil is low in organic matter, lime, and presumably phosphate, the addition of these amendments is necessary to obtain good results. A rotation including one or more legume crops is desirable. Runoff should be controlled, not only to prevent erosion but also to maintain an adequate supply of moisture for the plants. Under proper management a large number of different crops can be produced on this soil.

JEFFERSON SERIES

Like the soils of the Allen series, those of the Jefferson series are developed from colluvium and local alluvium derived from sandstone outcrops and soils derived from sandstone or mixtures of sandstone and shale, such as the Muskingum, Lehew, and Hector soils. The Jefferson soils differ from the Allen soils chiefly in that they are yellow rather than red in the subsoil, contain more stones and gravel, and are less productive. The Jefferson soils are well drained, strongly acid in reaction, low in fertility, and low in productivity. They do, however, respond to fertilization. Although they have favorable tilth, their workability is impaired by the content of gravel and stones. The Jefferson soils of Roane County are classified and mapped in one type and one phase, namely, Jefferson gravelly fine sandy loam and Jefferson gravelly fine sandy loam, slope phase. They cover a total area of only 3,392 acres, or 1.4 percent of the county.

Jefferson gravelly fine sandy loam.—Jefferson gravelly fine sandy loam has gently sloping or undulating relief, the slope in most places ranging from about 2 to 8 percent. This soil lies at the foot of ridge slopes on which sandstone outcrops and such soils as the Muskingum, Lehew, and Hector occur. The parent material is a mixture of colluvial and local alluvial material washed from these slopes. This soil is generally somewhat stony and gravelly, strongly acid in reaction, low in organic matter and mineral plant nutrients, and low in natural fertility. Drainage, for the most part, is good. Tilth in most places is favorable, but the abundance of stone and gravel interferes with tillage operations.

In most areas the 7- to 10-inch surface soil consists of grayish-yellow loose and open fine sandy loam. The subsoil consists of brownish-yellow or yellow friable fine sandy clay or fine sandy clay loam and ranges in thickness from about 18 to 24 inches. The material below the subsoil is rather brittle and is highly mottled with yellow, gray, red, and brown. It occurs in a layer about 6 to 18 inches thick and gives way to variable material consisting largely of a mixture of mottled sandy material and sandstone fragments.

Variations other than those in degree of development include soils that are shallow over residual material, are excessively stony, are heavier or lighter textured than typical, contain numerous shale fragments, or are somewhat imperfectly drained.

Jefferson gravelly fine sandy loam occupies a very small total area. Small bodies occur at the foot of most of the shale and sandstone ridges, at the foot of the Cumberland escarpment, and along the creeks in the Cumberland Plateau section. Some of the larger areas are between Oliver Springs and Scandlyn and in the vicinity of Paint Rock. This soil is associated with the Muskingum, Lehew, and Hector soils and rough stony land (Muskingum soil material) on the adjacent higher slopes; with the Allen soils in similar positions; and with soils of the terraces and bottom lands in adjacent lower positions.

Probably about 85 percent of this soil is cleared, most of which is in use for crops, hay, or pasture. The crops grown are those common for the county. Yields are somewhat lower than those obtained on Allen very fine sandy loam.

Although this soil is low in fertility, it is responsive to fertilization. With proper management, including particularly the application of lime, phosphate, and organic matter, it produces moderate yields of crops. This soil is not highly susceptible to accelerated erosion, and control of run-off may not be important on that account. Control of run-off, however, is important to conserve the moisture supply for growing plants, as the water-holding capacity of this soil is not high and crops readily suffer from drought.

Jefferson gravelly fine sandy loam, slope phase.—Jefferson gravelly fine sandy loam, slope phase, is differentiated from typical Jefferson gravelly fine sandy loam because of its steeper slope, which ranges from about 8 to 15 percent. Owing chiefly to that difference, the more sloping soil is less suitable for crop use. The variations in regard to depth over residual material, drainage, stone and gravel content, texture, and content of shale fragments are similar to the variations in the typical soil.

This soil is several times as extensive as the typical soil, but it does not occupy a large total area. In position, distribution, and association with other soils, it is similar to the typical soil.

About 65 percent of the land has been cleared. Probably about 30 percent is lying idle and is growing up to broomsedge, brush, and trees. About 35 percent is used for crops and pasture. Corn, small grains, and lespedeza are the main crops, with a small acreage of truck and fruit crops and tobacco. Yields are generally low.

The requirements of management and possibilities of use are the same for this soil as for typical Jefferson gravelly fine sandy loam,

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except that more attention should be given to the control of run-off on the slopes. Owing to the stronger relief, cultivation of this soil is somewhat more difficult than of the typical soil.

LEADVALE SERIES

In this county, the material giving rise to the soils of the Leadvale series has been washed chiefly from the Apison soils and the shales underlying the Apison soils. They occupy small areas at the foot of slopes, many of them in the form of small alluvial fans and cones at the mouths of short drains. In areas where the soils are fairly well developed they have brownish-gray surface soils and yellow subsoils. They resemble the Jefferson soils somewhat but differ from those soils in source of material. In addition, the Leadvale soils are practically free from stone, finer textured, and not quite so well drained as the Jefferson. The Leadvale soils are strongly acid in reaction, fairly well drained, and adapted to the production of most of the common agricultural crops. Only one type of this series is mapped in Roane County—Leadvale very fine sandy loam.

Leadvale very fine sandy loam.—Leadvale very fine sandy loam occupies colluvial and local alluvial positions at the foot of slopes. It has mild relief, acid reaction, fair to good drainage, moderate to low natural fertility, and moderate productivity. Stones are practically absent. The slope ranges from about 3 to 7 percent, although a few areas are nearly level and a few have a slope as great as 10 percent.

The accumulations from which Leadvale very fine sandy loam is developed differ in age from place to place. Where the accumulations are recent, the soil shows little development; but where the accumulations are rather old, the soil shows considerable development. In this county, probably most of the accumulations are old enough so that reasonably good soil profiles have developed. The 8- to 12-inch surface soil consists of brownish-gray, grayishyellow, or grayish-brown loose and open very fine sandy loam. The subsoil, ranging in thickness from 12 to 18 inches, is yellow or brownish-yellow firm but fairly friable silty clay loam. In many places a few mottlings are present in the lower part. Underlying this layer the material is rather brittle but friable, is highly mottled with gray, yelloy, red, and brown, and becomes more variable with increasing depth. The underlying shale residual material is reached in most places at a depth ranging from 3 to 5 feet.

Areas of soil varying somewhat from the typical in respects other than degree of development are included with this soil as mapped. The chief variations are in texture. In some places the soil is silt loam, and in a few places it is fine sandy loam. In some included areas the soil is imperfectly drained. The depth over residual material ranges from about 1 to 6 feet or more. Shale, which in most places is scarce, is abundant in some areas, and a few areas contain small sandstone fragments.

This soil occupies small areas at the foot of slopes, most of which do not exceed 15 acres in size. A few bodies are mapped at the heads of drains. The Leadvale soil is associated chiefly with the Apison soils and occurs mainly in the same general localities. It is widely distributed over the county, especially in the valleys of Stamp Creek, Paint Rock Creek, and Dry Fork Creek.

Although this soil is not extensive and occurs in rather small areas, it is important on many farms, as it generally occurs where other soils adapted to crops are scarce. Practically all of the areas of Leadvale very fine sandy loam have been cleared and put into cultivation. It is estimated that about 60 percent of the cleared land is used for the production of corn, small grains, hay, truck crops, and tobacco, and that about 40 percent is used for pasture. Lespedeza is the main hay and pasture plant. Yields of crops differ somewhat, depending largely on the management and the amount and distribution of moisture throughout the growing season, but yields in general are moderate to low.

Although this soil is only moderate in fertility, it is a fairly good soil for agriculture. It has favorable relief, low susceptibility to erosion, and good tilth, and it is well enough drained for the production of all the common crops. On the other hand, it is low in organic matter, low in lime, and presumably low in available phosphorus. If organic matter, lime, and other needed amendments are added to this soil, its productivity would very likely be greatly increased and a greater variety of crops could be grown. In its present acid condition practically no legumes except lespedeza can be grown successfully. This soil is fairly well adapted to the production of burley tobacco, and, where the land is properly fertilized, high-quality tobacco can be produced. It is also adapted to numerous truck crops, as well as corn, small grains, hay, and pasture.

GREENDALE SERIES

Soils of the Greendale series resemble soils of the Leadvale series in color, consistence, depth, manner of occurrence, relief, and drainage. The chief difference is that the parent materials of the Greendale soils are colluvial and alluvial materials washed chiefly from the Fullerton and Clarksville soils, whereas those of the Leadvale soils are washed chiefly from the Apison soils and the acid shales underlying them. Like the other soils developed from colluvium and local alluvium, the Greendale soils differ among themselves in degree of profile development. The soils with the better developed profiles have grayish-brown surface soils and yellow subsoils. The Greendale soils are well drained, are acid in reaction, have gentle relief, and are moderately productive of most of the commonly grown crops. Only one type is mapped, Greendale silt loam.

Greendale silt loam.—As stated, the materials giving rise to the Greendale soils are colluvial and local alluvial materials, most of which have been washed from the Clarksville and Fullerton soils. The typical occurrence for the Greendale soils is in small areas at the foot of rather long slopes, on which the soils are either Fullerton or Clarksville. Greendale silt loam has gentle relief, the slope in most places being less than 8 percent.

As with other soils developed from colluvium and local alluvium, Greendale silt loam differs considerably from place to place in degree of profile development. Where the parent material has recently accumulated, the soil shows very little development; but where the parent material has lain in place for considerable time, the soil shows greater development. Probably in most of the areas the soil shows a moderate degree of development and has a 6- to 9-inch surface soil

consisting of grayish-brown or brownish-gray loose and friable silt loam. The subsoil, ranging in thickness from 15 to 20 inches, consists of yellow, brownish-yellow, or reddish-yellow friable silty clay loam or silty clay. Below the subsoil the material is rather brittle but friable and mottled with yellow, red, gray, and brown. A few small chert fragments are scattered over the surface and throughout the soil mass in most places.

In some of the areas mapped as Greendale silt loam in the western part of the county the soil is lighter textured than typical. In a few places the local alluvium has been derived from Colbert and Talbott soils, and here the soil mapped as Greendale is heavier textured than typical. Also included are a few areas where the local alluvium was derived chiefly from Dewey soils, and here the soil mapped as Greendale is darker than typical.

This soil occurs chiefly in small areas at the foot of slopes on which the Clarksville or Fullerton soils occur. Most areas range from 5 to 15 acres in size. Some areas occur in narrow strips skirting the foot of the slopes, but most of them are in the form of alluvial fans and alluvial cones at the mouths of short drains. A few small areas are mapped in limestone sinks. Greendale silt loam is widely scattered over the county. It occurs at the foot of Walker, Chestnut, and Black Oak Ridges—ridges on which Fullerton and Clarksville soils are extensive—and in other sections where Clarksville and Fullerton soils are extensive. Some of the larger areas are between Glen Alice and Post Oak Springs and between Mary Crabtree School and Kingston. Others are in the vicinities of Ethel and New Hope School.

Practically all of this soil is cleared and is used for agriculture. About 70 percent of the land is devoted to corn, small grains, truck crops, and tobacco, 25 percent to hay and pasture, and the remaining 5 percent to orchards. This soil is somewhat more productive than Leadvale very fine sandy loam. In productivity, adaptability, and requirements of management it is similar to Fullerton cherty silt loam, smooth phase. Greendale silt loam is very well adapted to the production of burley tobacco and produces high-quality tobacco when the land is properly fertilized.

SOILS OF THE TERRACES

Soils of the terraces occupy ancient flood plains. In the geologic past, the present rivers and creeks flowed at considerably higher levels and deposited gravel, sand, and clay on their flood plains in the same manner as they are doing now. During the progress of stream cutting, over a great number of years, the channels were gradually deepened and new flood plains were formed at the lower levels, but remnants of the old higher lying flood plains were left. These areas are now above the overflow stage of the present streams, and they constitute what in this report are referred to as terraces. In brief, geologically they consist of general stream alluvium that lies above the overflow stage of the present streams. Frequently they are referred to as second bottoms, or benches.

These terraces, for the most part, lie adjacent to the present flood plains or bottom lands. Typically, the land is nearly level or gently sloping, but in Roane County many of the terraces are old and have been somewhat dissected by recent stream action, so that they now

have undulating or rolling relief. The soils of the terraces occupy 12,608 acres, or 5.2 percent of the county.

All the soils of the terraces are either very well or moderately well drained, are acid in reaction, and contain small to moderate quantities of water-worn gravel. Nearly all of them are adapted to crops, rank from comparatively low to fairly high in fertility, and respond well to good management. They are classified in four series, namely, Nolichucky, Waynesboro, Sequatchie, and Wolftever. The Nolichucky, Waynesboro, and Sequatchie soils probably developed from the same general kind of alluvium—alluvium that has come chiefly from uplands underlain by sandstone and acid shale. The differences in these soils arise chiefly from differences in their ages. The Nolichucky soils are the oldest, the Waynesboro soils somewhat younger, and the Sequatchie soils much younger. Soils of both the Nolichucky and Waynesboro series are well developed. They differ chiefly in the color of their surface soils, which in the Nolichucky are yellowish gray or brownish gray and in the Waynesboro are grayish brown or light brown. In members of both series the subsoils are chiefly yellowish red. The Sequatchie soils, which occur on lower and much younger terraces, have weakly developed profiles with light-brown or grayish-brown surface soils and chiefly yellowish-brown subsoils. The Wolftever soils are developed from alluvium derived mostly from uplands underlain by limestone, but some is derived from uplands underlain by sandstone, shale, and crystalline rocks. The Wolftever soils have fairly well developed profiles with light-brown surface soils, yellowish-brown subsoils, and rather conspicuously mottled compact layers below the subsoils.

NOLICHUCKY SERIES

Soils of the Nolichucky series occupy the older higher lying terraces. The alluvium giving rise to these soils originated chiefly from sandstone and shale and has lain in place long enough for well-developed soil profiles to have formed. These soils have yellowish-gray or brownish-gray surface soils and yellowish-red subsoils. They resemble the Waynesboro soils but differ from those soils principally in having lighter colored surface soils. The Nolichucky soils are friable, are strongly acid in reaction, are low in organic matter, have good tilth conditions, are medium to low in fertility, and are medium to low in productivity. They range from undulating to rolling in relief, the slope ranging from about 2 to 15 percent. They are adapted to the production of crops. In Roane County the soils of this series are classified and mapped in one type and two phases, namely, Nolichucky very fine sandy loam; Nolichucky very fine sandy loam, eroded phase; and Nolichucky very fine sandy loam, slope phase. They do not cover a large total area, and they occur chiefly along the rivers.

Nolichucky very fine sandy loam.—Nolichucky very fine sandy loam is well developed, well drained, strongly acid in reaction, low in organic matter, and permeable to air, roots, and water. It has a moderate water-holding capacity, contains some water-worn gravel, is of medium fertility, has a wide range in adaptability to crops, and responds to good management. The relief is undulating, and the slope ranges from 2 to 7 percent.

In uneroded fields this soil has an 8- to 12-inch yellowish-gray, brownish-gray, or light-gray loose and open very fine sandy loam surface soil. The subsoil consists of yellowish-red, red, or reddish-yellow firm and moderately friable very fine sandy clay from 20 to 26 inches thick. Underlying the subsoil, the material is somewhat compact but fairly friable very fine sandy clay, highly mottled with red, brown, yellow, and gray. This continues to the base of the alluvial deposit, which ranges from less than 3 feet to more than 10 feet in depth. In some areas this lowest layer is heavy, sticky, and plastic. Varying quantities of gravel are scattered throughout the soil, but in most places the content is not sufficient to interfere materially with tillage.

This soil is of small extent. Most of the areas are along the Emory River south of Webster. A few are along the Tennessee and Clinch Rivers and some of the larger creeks, especially northeast and southwest of Lawnville. Probably most of the bodies are associated with and surrounded by Nolichucky very fine sandy loam, eroded phase, and Nolichucky very fine sandy loam, slope phase; but in places they are associated with almost every other soil in the county. In the section south of Webster, some bodies adjoin areas of the Colbert, Talbott, Hector, and Muskingum soils of the uplands; the Sequatchie soils of the terraces; and the Pope, Philo, and Atkins soils of the bottom lands. The areas northeast of Lawnville are isolated from other soils on the terraces and bottom lands. They are surrounded by the Allen soils of the colluvial lands and the Colbert, Talbott, and Fullerton soils of the uplands.

Nearly all of Nolichucky very fine sandy loam has been cleared and is used for the production of crops, chiefly corn, small grains, hay, and some truck and fruit crops. Acre yields usually are only moderate, with 20 bushels frequently reported for corn, 8 to 10 bushels for wheat, and 1 to 1½ tons for hay. Some fertilizer generally is applied for these crops.

The productivity of this soil can be considerably increased by the application of organic matter, lime, phosphate, and probably potash, as the soil is naturally low in organic matter and lime and presumably in available phosphorus; but the physical condition is favorable for plant growth, and the good tilth and gentle relief favor easy workability. As this soil is somewhat susceptible to accelerated erosion and does not have a high moisture-holding capacity, prevention of run-off to control erosion and conserve water for plant use is highly desirable. Under good management, including particularly the addition of needed amendments, this soil should return considerably greater yields than it does at present.

Nolichucky very fine sandy loam, slope phase.—Nolichucky very fine sandy loam, slope phase, differs from the typical soil chiefly in having a steeper slope with a gradient ranging from about 7 to 15 percent. Except for slightly more variability and probably slightly thinner soil layers, the profile of this soil is similar to that of the typical soil. In several areas the topmost few inches of the surface soil have been lost through accelerated erosion. Included with areas of this sloping soil is a variation in which the subsoil is heavier textured than typical. The total area of this variation is small.

Soil of the slope phase occurs chiefly on the gently rolling terrace lands along the rivers and large creeks. Although it is associated chiefly with other Nolichucky soils, it is associated with several other soils. Some of the larger areas occupy the terraces along the Emory River from Harriman to the point where this stream flows into the Clinch River, north of the confluence of Poplar Creek and the Clinch River, along the Tennessee River just north of Hood Landing, and about 2 miles northeast of Luminary Church. About 85 percent of the land has been cleared and put into cultivation. The proportionate extent of the cleared land devoted to the production of the different crops is about the same as for the typical soil, but the yields on this soil are probably a little lower. Owing to its stronger relief, this soil requires greater care to control run-off, but in other requirements of management it is similar to typical Nolichucky very fine sandy loam.

Nolichucky very fine sandy loam, eroded phase.—Nolichucky very fine sandy loam, eroded phase, differs from the typical soil in that most of the original surface soil of the eroded soil has been lost by accelerated erosion; and, in addition, soil of the eroded phase has a wider range in relief, including not only undulating areas but also gently rolling areas. The slope ranges from 3 to 15 percent and in most places from 6 to 12 percent. The degree of erosion varies somewhat from place to place. In some areas a few inches of the original surface soil remain; in others all the original surface soil and part of the original subsoil have been lost. There are a few gullies in some areas. Except for the difference in relief, this soil originally was similar to typical Nolichucky very fine sandy loam; but improper use, poor management, or both, and inadequate control of run-off resulted in considerable erosion of the soil material and the development of this eroded soil.

Although this soil covers a small total area, it is more extensive than either of the other soils mapped in the Nolichucky series. Areas of this soil are along the Emory, Clinch, and Tennessee Rivers. The most extensive areas occur along the Emory River from Harriman to the confluence of the Emory and Clinch Rivers, and an extensive area is in the vicinity of the confluence of Poplar Creek and the Clinch River. This soil is associated geographically with many other soils. The chief associates probably are other Nolichucky soils; but some areas border other soils that occur on the terraces; the Pope, Philo, and Atkins soils of the bottom lands; and the Colbert, Talbott, Fullerton, Muskingum, and Hector soils of the uplands.

All areas of this soil have been cleared. It is estimated that probably one-half of the soil is abandoned to poor pasture or idle land and is growing up to weeds and bushes, and about one-half is used for the production of crops, chiefly corn, small grains, and hay, with a small acreage devoted to truck and fruit crops. Yields are generally low and uncertain where the management is poor, but where the management is fairly good, yields are moderate.

Although this soil has been injured by erosion, it responds fairly well to measures for improvement. It is low in organic matter, lime, and presumably in phosphate; and the tilth has been slightly impaired, largely by erosion. Control of run-off to conserve water for use by plants and to prevent further erosion, the application of

needed amendments, and a rather long rotation in which close-growing crops are emphasized, would return this soil to a state of moderate productivity in a comparatively few years.

WAYNESBORO SERIES

Like soils of the Nolichucky series, the soils of the Waynesboro series occupy the older higher terrraces and are developed from general stream alluvium, most of which has been derived from sandstone and acid shale. Like the Nolichucky soils, the Waynesboro soils are well developed but probably are somewhat younger and less severely leached. The chief difference between the Nolichucky and the Waynesboro soils is that the latter have darker surface soils and apparently contain more organic matter.

Soils of the Waynesboro series have light-brown or grayish-brown surface soils and yellowish-red, red, or reddish-yellow friable subsoils. The reaction is acid. These soils are permeable to air, water, and roots and are well drained, both internally and externally. They have moderate water-holding capacity, good tilth, a moderate content of organic matter, and a moderate to low supply of mineral plant nutrients. Some water-worn gravel and sandstone are present. Natural fertility is moderate to comparatively low. The relief is undulating to hilly, as the slope ranges from about 3 to probably 25 percent; but gently rolling relief predominates.

The soils of the Waynesboro series are classified and mapped in one type and two phases, namely, Waynesboro very fine sandy loam; Waynesboro very fine sandy loam, slope phase; and Waynesboro very fine sandy loam, eroded hill phase. The total area covered by these soils is not large.

Waynesboro very fine sandy loam.—Waynesboro very fine sandy loam has developed on rather old terraces consisting of alluvium, most of which originated in uplands underlain by sandstone and shale. This soil is strongly acid in reaction, is permeable to air, water, and plant roots, and is well drained, both internally and externally. It has moderate water-holding capacity and good tilth. Some water-worn gravel is present. The supply of organic matter is moderate, and the supply of mineral plant nutrients is moderate to low. Natural fertility is moderate to comparatively low. The relief is undulating, the slope ranging from about 2 to 7 percent.

In uneroded fields, Waynesboro very fine sandy loam has a 6- to 10-inch surface soil of light-brown or grayish-brown loose and friable very fine sandy loam. The subsoil, about 24 to 28 inches thick, consists of yellowish-red, red, brownish-red, or reddish-yellow friable and crumbly very fine sandy clay. The material below the subsoil is somewhat brittle very fine sandy clay, chiefly red but mottled with yellow, gray, and brown. This material generally continues, with increased mottling, to a depth of 5 feet or more. The depth of alluvium ranges from about 3 feet to probably more than 10 feet. Pieces of quartz gravel occur in most areas of this soil, but generally they are not numerous enough to interfere with tillage, although in some places the substratum has a high content of gravel and cobbles. In several areas some accelerated erosion has taken place, and here the surface soil is correspondingly thinner.

This soil occupies a very small total area. Bodies occur along the rivers and large creeks, especially along the Tennessee River. The largest areas include those southwest of Hood Landing Ferry, totaling from 150 to 200 acres; an area of about 150 acres is about 2 miles southwest of Kingston, and a 50-acre body is 2 miles east of Tennessee Chapel. This soil is associated mainly with Waynesboro very fine sandy loam, slope phase; but it is associated also with the other soils of the terraces and bottom lands and with the Dewey and Fullerton soils of the uplands.

Practically all of this soil is cleared. About 70 percent of the cleared land is used for crops, mainly corn, small grains, and hay; 5 percent for fruit and truck crops; and 25 percent for pasture. The requirements of management and the adaptability of the soil to crops are similar to those of Nolichucky very fine sandy loam, but under similar management slightly higher yields may be expected on the Waynesboro soil.

Waynesboro very fine sandy loam, slope phase.—This soil differs from the typical soil chiefly in having more pronounced relief, as the slope ranges from 7 to 15 percent. In addition, the sloping soil has lost from one-half to all of the original surface soil through erosion. The soil profiles of the two soils are similar, except that there is more variability and a shallower surface soil in the slope phase.

This soil is associated with other Waynesboro soils, other soils of the terraces and bottom lands, and the Dewey and Fullerton soils of the uplands. It occupies rolling terraces along the rivers and large creeks. Fairly large bodies are near Kingston, southwest of Hood Landing Ferry, about 2½ miles south of Dogwood School, and about 2 miles southeast of Dogwood School.

Practically all of this land is cleared. It is estimated that about 60 percent of the cleared land is used for the production of crops, chiefly corn, small grains, and hay; 25 percent is in pasture; and 15 percent is lying idle and growing up to weeds and bushes. Crop yields in general are rather low. The requirements of management of this soil are similar to those of Nolichucky very fine sandy loam; but, under similar management, slightly higher yields are obtained on the Waynesboro soil.

Waynesboro very fine sandy loam, eroded hill phase.—This soil is hilly and, in cleared areas, is eroded. The slope ranges from 15 to 30 percent. An estimated 60 percent of the total area of this soil is cleared, and on these areas accelerated erosion has removed nearly all of the original surface soil and, in some places, part of the subsoil. Many gullies have formed. Originally, the profile of this soil was similar to that of typical Waynesboro very fine sandy loam, except probably for more variability and less average thickness of the soil layers. Included in this soil as mapped are several areas of a soil that is similar to the eroded phase of Nolichucky very fine sandy loam but differs in having hilly instead of gently rolling relief; in fact, this soil includes practically all of the soil of the terraces that has hilly relief and, where cleared, is eroded.

Only a small area of this soil is mapped. It occurs on the hilly terraces along the rivers and is associated with other soils of the terraces and bottom lands and with the Clarksville, Fullerton, Dewey,

and Talbott soils of the uplands. Some areas flank the short drains that have cut through the terraces, and some are on the escarpments between the terraces and bottom lands. A few large areas are mapped along the Tennessee River near the Loudon-Roane County line south of Dogwood School and 2 miles southeast of New Hope School.

It is estimated that about 40 percent of the total area occupied by this soil is still in woods. Most of the woods are on the large areas mapped along the Tennessee River near Dogwood School and south of New Hope School. Probably less than 20 percent of the land is used for crops, chiefly corn, small grains, and hay. The productivity is prevailingly low. Some land is used for pasture, and lespedeza is the principal pasture plant. Probably more than one-half of the total cleared area is lying idle and is growing up to weeds and brush.

Owing chiefly to the hilly relief, this soil is not considered suitable for the production of intertilled crops and is but poorly suited to close-growing crops. In addition to having a hilly relief, it is eroded and highly susceptible to further erosion, is comparatively low in natural fertility, and is generally low in productivity. With proper management, including the application of lime and phosphate, the choice of pasture plants, and the periodic eradication of weeds, it will produce fair pasture.

SEQUATCHIE SERIES

The soils of the Sequatchie series are young, showing some but not much development. Like the Nolichucky and Waynesboro soils, the Sequatchie soils are developed from terrace material, most of which has come from uplands underlain by sandstone and, to less extent, from uplands underlain by shale. They differ from both the Nolichucky and the Waynesboro soils chiefly in having yellowish-brown subsoils, but they also occupy lower younger terraces than do those soils. The Sequatchie soils have light-brown surface soils and yellowish-brown subsoils. They are friable throughout, are well drained and are permeable to air, water, and roots. The reaction is strongly acid. These soils have a moderate content of organic matter and a moderate to low water-holding capacity. Ordinarily, a few pieces of gravel and a few cobbles are present. Fertility and productivity are about medium. The land is nearly level to gently rolling, the slope ranging from about 1 to 15 percent.

In Roane County the soils of this series are classified and mapped in one type and one phase—Sequatchie very fine sandy loam and Sequatchie very fine sandy loam, slope phase. They cover a small total area. They are adapted to the production of most of the common crops.

Sequatchie very fine sandy loam.—The surface of Sequatchie very fine sandy loam is nearly level or gently undulating, and the slope ranges from 1 to 7 percent. This soil has an 8- to 12-inch surface soil of light-brown or brown loose and open very fine sandy loam. The subsoil, ranging in thickness from 20 to 30 inches, consists of yellowish-brown or light-brown loose and friable very fine sandy clay loam. In most places the material below the subsoil is some shade of brown mottled with yellow, gray, and a little red.

Some variability occurs in this soil as mapped. In some places the surface soil approaches loamy fine sand in texture and extends to a depth of 15 to 20 inches. In other places the surface soil is silt loam and the subsoil is silty clay loam. Areas of this variation occur where much of the alluvial material originated in uplands underlain by shale. In some places the subsoil has a light-red cast, and in others it is darker brown than typical.

This soil occurs in rather elongated areas on the lower terraces along the rivers and the larger creeks, whereas the Nolichucky and Waynesboro soils occur chiefly on the older terraces. Some areas are in the northeastern part of the county along Indian and Poplar Creeks and East Fork Poplar Creek; some are along the Emory River about 2½ miles north of Kingston; and some are along the Tennessee River southwest of Kingston, in the vicinity of New Hope School, and on Long Island. Typically, this soil is associated with soils of the bottom lands, chiefly Pope fine sandy loam, on the lower side, and soils of the uplands, colluvial lands, or terraces, on the upper side. The chief associations on the upper side are the Apison soils of the uplands and the Nolichucky and Waynesboro soils of the terraces.

Nearly all of this soil is cleared, and it is estimated that about 50 percent of the cleared land is used for crops, mainly corn, small grains, and truck crops, and about 50 percent for hay and pasture. Moderate yields are obtained.

This soil has several favorable qualities. The gentle relief and good tilth favor easy workability. Drainage and aeration are good, and plant roots easily penetrate the soil. This soil is responsive to fertilization. Physically, it is adapted to the production of many crops. Organic matter, however, is readily dissipated if the soil is used for such crops as corn and small grains; and the soil is low in lime and presumably in phosphate. If the needed amendments, particularly lime and phosphate, were applied to this soil, its productivity would be increased considerably and a greater variety of crops could be grown successfully.

Sequatchie very fine sandy loam, slope phase.—The chief difference between Sequatchie very fine sandy loam, slope phase, and the typical soil is that soil of the slope phase has a steeper slope, ranging from 7 to 15 percent, although it exceeds 12 percent in but few places. In profile features the two soils are similar. Accelerated erosion has taken place on a few of the areas of this sloping soil, and in such places the surface soil is correspondingly thinner.

Only a very small total area of this soil is mapped. The soil is associated chiefly with typical Sequatchie very fine sandy loam and to less extent with other soils of the terraces. The largest body lies along Poplar Creek about 2 miles south of Oliver Springs.

Most of the land has been cleared. Probably between one-half and three-fourths of the cleared land is used for crops, chiefly corn, small grains, and hay; some is used for pasture; and some is lying idle and growing up to weeds and bushes. Yields generally are a little lower than on the typical soil.

The requirements of management are similar to those of the typical soil, except for the necessary variations because of the stronger relief, which means that more attention must be given to the control of run-off

WOLFTEVER SERIES

Soils of the Wolftever series are developed from terrace material probably derived largely from uplands underlain by limestone and to less extent from uplands underlain by shales, sandstones, and crystalline rocks. These soils occupy low terraces, some of which are subject to overflow during exceptionally high floods. External drainage is generally sufficient, but internal drainage is retarded by a compact layer ranging from 2 to 3 feet below the surface. Drainage is adequate, however, for the production of corn, small grains, and grasses. Although these soils are comparatively young, they appear to have undergone considerable development. In general the surface soils are light brown and the subsoils yellowish brown. A distinctive feature of these soils is the presence of the compact layer just below the subsoil. These soils are strongly acid in reaction and have a moderate content of organic matter and a rather low supply of lime and presumably phosphate. Aeration is imperfect, and roots penetrate below a depth of about 2 feet with difficulty. The relief is very gentle, and the productivity is moderate to high. In Roane County the soils of this series are classified and mapped in one type and one phase—Wolftever silt loam and Wolftever silt loam, slope phase. The total area covered by these soils is small.

Wolftever silt loam.—Wolftever silt loam has gentle relief, with the slope ranging from 1 to 7 percent and being less than 5 percent in most places. It has an 8- to 12-inch surface soil of light-brown or grayish-brown friable silt loam. The subsoil is about 12 to 16 inches thick and consists of yellowish-brown, brownish-yellow, or yellow firm silty clay loam. A few gray and brown mottlings generally are present in the lower part. Below the subsoil is the 1- to 2-foot compact layer of brownish-yellow or yellowish-brown compact and tight silty clay loam or silty clay, highly mottled and streaked with gray, yellow, and brown. This layer is nearly impervious to water and plant roots.

As mapped, this soil includes a variation with a light reddish-brown surface soil and a reddish-yellow friable subsoil. Also included are a few areas on high terraces, probably 50 feet or more above the present stream level. In these higher positions, the soil has a lighter colored surface soil and is slightly less productive.

Wolftever silt loam covers a small total area, mainly on low terraces along the Tennessee River, where it occupies elongated areas adjacent to the first bottoms. The largest bodies are northeast and northwest of Luminary Church and in the vicinity of Seven Islands. A few small areas are along Poplar Creek and the Clinch River, especially near the Roane-Loudon County line. Nearly all of the areas of this soil along the Tennessee River adjoin areas of Huntington silt loam of the bottom lands. Some of the areas along Poplar Creek and the Clinch River adjoin areas of Huntington silt loam also, but most of them adjoin areas of the Pope soils, mainly Pope very fine sandy loam. Other soils associated with Wolftever silt loam are the Nolichucky, Waynesboro, and Sequatchie soils of the terraces and the Dewey, Fullerton, Clarksville, and Apison soils of the uplands.

Practically all of this land has been cleared, and most of it is used for the production of corn, small grains, and hay. As compared with those on other soils of the county, yields are moderate

to high but are probably a little lower than on Dewey silt loam and considerably lower than on Huntington silt loam.

The feature of Wolftever silt loam that detracts from its agricultural value is the compact layer just below the subsoil. This compact layer inhibits internal drainage and penetration of roots. Deep-rooted plants, such as alfalfa and certain clovers, do not do so well on Wolftever silt loam as on such soils as Dewey silt loam and Dewey silty clay loam. Adaptability to different crops, therefore, is limited by this layer, although most of the common farm crops are grown with success, and this soil ranks among the more desirable soils for agriculture in the county. Its very gentle relief favors tillage operations and minimizes the problem of the control of run-off. The tilth is also favorable. The supply of organic matter has been depleted to a great extent, and the contents of lime and presumably phosphate are comparatively low. Maintenance of a high level of productivity requires the application of these needed amendments.

Wolftever silt loam, slope phase.—Wolftever silt loam, slope phase, differs from typical Wolftever silt loam chiefly in its steeper slope, which ranges from 7 to 15 percent. In addition, erosion has reduced the surface soil to a thickness of 3 to 6 inches. The layers below the surface soil are similar to the corresponding layers of typical Wolftever silt loam. Included with soil of this slope phase as mapped are areas of soil that are gradational to the Waynesboro, Nolichucky, and Sequatchie soils.

This sloping soil is very inextensive. Probably most of the areas are associated with the variation of Wolftever silt loam that lies on the higher terraces, where areas of the slope phase flank the drains that have cut through the terraces and also occupy sloping strips bounding the bottom lands. Most of the areas that do not occupy such positions are underlain by shale at a depth of 2½ to 3 feet. Most areas of this sloping soil are small, and probably most of them are scattered along the Tennessee River.

All or nearly all of the areas of this soil are cleared and are used chiefly for crops, such as corn, small grains, and hay. Yields are probably about 10 percent lower than on typical Wolftever silt loam. As this soil generally occupies small individual areas, its use is largely determined by the use of the more extensive soils with which it is associated.

In regard to adaptability and requirements of management, this sloping soil is similar to typical Wolftever silt loam, except for the differences arising from the greater slope and the slightly to moderately eroded condition.

SOILS OF THE BOTTOM LANDS

By the term bottom lands is here meant the flood plains, or those nearly level areas, along the streams, that are subject to overflow. The material giving rise to all the soils in the bottom lands has been carried there by the streams, and its character depends greatly on the source of the soil materials in the higher lying lands and the rate at which the water was moving when the material was deposited.

All the soils in the bottom lands are young and immature, considered genetically. The material from which these soils are developing has not lain in place long enough for the dynamic forces

of soil genesis to develop distinct horizons, or layers. In a sense, therefore, these soils are essentially parent materials that have undergone little change since deposition.

The soils of the bottom lands are classified in seven soil series largely on the basis of differences in source of the alluvial material and on differences in drainage. Altogether, they occupy 26,752 acres, or about 11 percent of the county's area.

The material of the soils of the Pope, Philo, and Atkins series originated in those uplands that are underlain chiefly by sandstone and shale. The soils of these three series constitute a catena [6] in which the Pope soils are well drained, the Philo soils are intermediately drained, and the Atkins soils are poorly drained. The material of the soils of the Huntington, Lindside, and Melvin series comes chiefly from those uplands that are underlain by limestone. The soils of these series also constitute a catena in which the Huntington soils are well drained, the Lindside soils are intermediately drained, and the Melvin soils are poorly drained. The Pope, Philo, and Atkins soils are generally strongly acid in reaction, whereas the Huntington, Lindside, and Melvin soils are generally neutral to medium acid in reaction. The Huntington and Pope soils are comparable in drainage, and both are brown, but the Pope soils are lighter brown. Likewise, the Lindside and Philo soils are comparable in drainage conditions, and they are brown to a depth of about 1 foot, below which they are highly mottled. The Atkins and Melvin soils are also comparable in drainage conditions, the soils of both series being very poorly drained, and they are mottled and variegated from the surface down.

The seventh series of the bottom lands includes the Roane soils. Soils of the Roane series are distinctive in that a semicemented bed of chert fragments lies from 15 to 30 inches below the surface in most places. These soils occupy the bottom-land strips along the small streams that drain large areas of the Clarksville and Fullerton soils, particularly the Clarksville. Drainage of the Roane soils is fairly good.

HUNTINGTON SERIES

The Huntington soils are well-drained friable brown highly productive soils of the first bottoms. Most of the material of these soils has originated in those uplands underlain by limestone, but some apparently has come from uplands underlain by crystalline rocks, shales, and sandstones. Soils of this series occur mainly along the Tennessee River, where they are very important agriculturally. Only one type of this series is mapped—Huntington silt loam.

Huntington silt loam.—Huntington silt loam occupies first bottoms that are subject to periodic overflow and as a result receive small additional deposits of alluvial material nearly every year. Most of the material of this soil has originated in uplands underlain by limestones, although some has originated in uplands underlain by other rocks, such as shales, sandstones, and crystalline rocks. This soil is well drained. It is young and has undergone but little development, so that the difference between the surface soil and the

[6] A group of soils developed from similar parent materials but with different characteristics due to differences in relief.

subsoil is slight. This soil is mellow and friable to a depth of more than 36 inches. In most places it is rich-brown mellow silt loam to a depth ranging from 12 to 24 inches, below which the material generally becomes a little lighter in color and slightly heavier in texture, being light-brown or yellowish-brown heavy silt loam. At a depth of 3 to 4 feet the material becomes mottled with gray, yellow, and brown.

The 12- to 24-inch layer of surface soil is rich in fairly durable humus. The reaction is about neutral or only slightly acid, indicating a fairly abundant supply of lime, and the supply of other plant nutrients seems to be equally adequate. Most of this soil contains a few mica flakes. Tilth is excellent, and the occurrence of stones is unusual. The land is nearly level, nowhere exceeding a 2½-percent slope. Although surface run-off is slow, internal drainage is good.

Included with this soil as mapped are a few areas where the soil is somewhat heavier textured and less friable than typical, also a few areas where the soil is lighter textured than typical.

Huntington silt loam occurs chiefly along the Tennessee River in long continuous strips, which in very few places are more than a quarter of a mile wide. A few areas are mapped along the Clinch River. This soil is associated with Pope very fine sandy loam, Lindside silt loam, Melvin silt loam, and the soils of the terraces, chiefly Wolftever silt loam.

Practically all of the land is cleared and is used for crops. Corn, the chief crop, is admirably adapted to this soil. Other crops grown are small grains, hay, and truck. Yields in general are high; acre yields of 35 to 55 bushels of corn and 2 to 3 tons of hay are frequently reported. Fertilizers are not generally used.

Huntington silt loam is characterized by favorable conditions of productivity, workability, and fertility and is, therefore, well adapted to many crops. It is one of the very best soils for corn in the county, and in many places corn follows corn year after year. Grasses, many clovers, and truck crops do very well. Alfalfa would grow well but would be subject to injury during periods of flooding. Small grains frequently grow rank and lodge, and in addition they are more susceptible to injury from rust than when grown in the uplands. Burley tobacco tends to grow rank and to be of lower quality than when grown on suitable soils of the uplands.

LINDSIDE SERIES

Soils of the Lindside series resemble soils of the Huntington series in source of material, texture, and consistence. They differ from the Huntington soils chiefly in having poorer internal drainage, the Lindside soils being intermediate in drainage between the Huntington and Melvin soils. The Lindside soils are comparable to the Philo soils in drainage conditions, but they differ from those soils in source of material and acidity. The surface soils of the Lindside soils are brown, and the subsoils are highly mottled. Only one type, Lindside silt loam, is mapped.

Lindside silt loam.—Lindside silt loam is intermediate in drainage. The material giving rise to this soil originated chiefly in the uplands underlain by limestone. This soil is friable and is neutral

to slightly acid in reaction. The supply of plant nutrients is good, and the surface is nearly level, the slope being less than 3 percent.

In most places this soil is brown mellow silt loam to a depth ranging between 12 and 18 inches, below which the material is rather highly mottled with gray, yellow, blue, brown, and a little red. This mottled material is friable heavy silt loam and continues to a depth below 30 inches with little change except an increase in the gray and blue mottlings in most places. During rainy periods this mottled material is waterlogged much of the time.

Certain variations occur in this soil. In some places the subsoil is silty clay loam rather than heavy silt loam, and in others a few fragments of chert and pieces of gravel are present. A marked variation consists of a soil that is similar to typical Lindside silt loam, particularly in drainage condition, but differs in topographic position, geographic association, and source of material. This variation occupies depressions, or sinks, in the uplands and is associated chiefly with the Clarksville and Fullerton soils and to less extent with the Dewey and Talbott soils. The material of the soil of this variation is essentially local alluvium that has been washed into the depressions from the adjoining hillsides. Individual areas of this variation are generally small, and most of them occur on Black Oak, Chestnut, and Copper Ridges, ridges that are underlain by cherty dolomitic limestone. In productivity and adaptability the soil in these places is similar to typical Lindside silt loam of the bottom lands, except that artificial drainage generally is not possible. The total area occupied by the soil of this variation is about 200 acres.

Lindside silt loam covers only a small total area. Except for those areas of the variation just described, this soil occurs along the Tennessee River, the Clinch River, and the smaller streams that chiefly drain uplands underlain by limestones. Most of the bodies are narrow and elongated, and those along the Tennessee River lie farther away from the channel than the Huntington soils, with which this soil is associated in most places. Some of the areas lie in the old river channels that are nearly filled with recent alluvium, and some lie along the drains that have cut through areas of the Wolftever soils of the terraces. Lindside silt loam along the Tennessee River is associated chiefly with the Huntington and Melvin soils of the bottom lands and the Wolftever soils of the terraces; the Lindside soils along the small streams are associated chiefly with the Clarksville, Fullerton, Dewey, Talbott, and Colbert soils of the uplands.

It is estimated that about 60 percent of the total area of Lindside silt loam is used for the production of corn, 20 percent for hay, and 20 percent for pasture. Yields of corn vary somewhat from year to year, depending on moisture conditions during the growing season. When the rainfall is high, corn generally suffers from wet conditions and the yields are correspondingly low; but when the rainfall is normal or somewhat less than normal, corn returns nearly as high yields as on Huntington silt loam. Considerable damage from wet conditions is to be expected about 2 or 3 years out of 10. Ordinarily, no fertilizer is applied.

Owing chiefly to the intermediate drainage condition of this soil, it is not adapted to so many crops as Huntington silt loam. Crops

sensitive to wet conditions will not do well, except when no periods of heavy rainfall occur during the growing season. This soil, however, is well enough drained that crops not more sensitive than corn to wet conditions will grow well in most seasons. Crops are subject to injury from flooding during the growing season. The physical condition of this soil is such that it can be easily drained by artificial means in areas where drainage is feasible. In its natural condition the soil is admirably suited to pasture or hay.

MELVIN SERIES

The Melvin soils are poorly drained. They are young soils of the bottom lands and occur in association with the Huntington and Lindside soils. The alluvium giving rise to them is similar to that giving rise to the Huntington and Lindside soils; that is, it has come chiefly from uplands underlain by limestone. The Melvin soils differ from the Lindside soils in that they are poorly drained and are mottled from the surface down. They are comparable with the Atkins soils in drainage conditions but differ from those soils in source of material and in reaction. The Melvin soils in general are neutral to medium acid. Only one type is mapped in Roane County—Melvin silt loam.

Melvin silt loam.—Melvin silt loam is poorly drained and subject to frequent flooding. This soil is generally gray silt loam to a depth ranging from 3 to 8 inches, in most places containing some yellow and brown mottlings. This material grades into friable heavy silt loam or silty clay loam highly mottled with gray, yellow, blue, red, and brown. This continues to a depth of more than 30 inches with no appreciable change except an increase in the proportion of gray and blue mottlings. The reaction is generally neutral to medium acid.

Some variations are included with this soil as mapped. In a number of places the surface soil is silty clay loam and the subsoil is silty clay that is somewhat sticky and plastic. A few swampy areas, such as those south of Rockwood near Hopewell School, are indicated by symbols on the map. Also included are a few small poorly drained areas in depressions or sinks in the uplands, in which the material is local wash from the Clarksville, Fullerton, Dewey, Talbott, or Colbert soils.

Except for the small areas occurring in the sinks in the uplands, all this soil lies in the bottom lands, and probably most of the bodies are along the Tennessee River, although some are along the small creeks that drain chiefly uplands underlain by limestone. In the bottoms, such as those along the Tennessee River, this soil occurs in narrow strips along the outer edges of the bottoms and in the old river channels. Most of the individual areas are small. This soil is associated mainly with the Huntington and Lindside soils on one side and soils of the terrace lands or uplands on the other.

The greater part of the land has been cleared, and most of the cleared areas are used for pasture or hay. Some are used for the production of corn. Yields of corn are uncertain, and frequently the crops fail completely; but in dry years corn produces fairly well. Owing to its poor drainage, this soil is poorly suited to corn and most other crops except hay. It produces good hay and pasture. If adequately drained by artificial means, this soil would produce high yields of corn and a number of other crops.

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ROANE SERIES

The Roane soils occupy strips of bottom land along the small streams that drain chiefly areas of the Clarksville and Fullerton soils, particularly the Clarksville. Their most conspicuous characteristic is the semicemented layer of angular chert fragments occurring from 15 to 30 inches below the surface. Most of these soils are subject to occasional overflows, and alterations result from scouring and deposition. These soils are acid in reaction. Only one type is mapped in this county—Roane gravelly loam.

Roane gravelly loam.—Material giving rise to Roane gravelly loam is washed chiefly from upland areas of the Clarksville and Fullerton soils, particularly the Clarksville. In Roane County a few small areas have received a small amount of material from uplands underlain by sandstone and shales. The semicemented layer of cherty fragments is a conspicuous feature of Roane gravelly loam. This soil is fairly well drained and moderate to low in productivity. It has a moderate content of organic matter and a rather low water-holding capacity. The reaction is acid. The relief ranges from nearly level to gently sloping, and in most places the slope is from 1 to 3 percent.

Roane gravelly loam is grayish-brown or light-brown loose and open cherty silt loam to a depth ranging from 15 to 30 inches, where the bed of chert lies. This bed of cherty material is variable in thickness but is generally more than 1 foot thick. The chert fragments are tightly embedded, and the soil material between the chert fragments in most places is somewhat cemented, particularly in the upper 6 or 8 inches. In some places the upper part of this layer is rather firmly cemented. Most of the soil material in this layer is mottled with brown, gray, and yellow. Very few plant roots are in this layer. In a few places the depth to the cherty layer is only about 10 inches. In some of the places where the depth to the cherty layer is about 24 inches or more, two discernible soil layers have developed over the cherty layer. The 10-inch surface layer is grayish-brown cherty silt loam, and the subsoil layer, which continues down to the chert bed, is yellowish-brown or brownish-yellow heavy silt loam or silty clay loam. Like the surface soil, this subsoil layer contains chert fragments and is friable and open. A few mottlings of yellow, brown, and gray are present in places in the lower part.

In spite of the fact that this soil has a semicemented layer, it seems to be well drained. This soil, particularly where it is rather shallow over the cherty layer, dries out rather quickly, and in dry periods crops suffer greatly from lack of moisture.

Roane gravelly loam occurs along the short streams that head in areas of Clarksville and Fullerton soils. Many of these streams are intermittent. Most of the areas are narrow, are less than 200 feet wide, and are flanked by rather steep slopes of Clarksville or Fullerton soils. Most of them lie along or near Copper, Chestnut, Walker, and Black Oak Ridges. One of the largest areas is near the eastern boundary of the county along Pawpaw Creek.

Practically all of this land is cleared and used for the production of corn, hay, pasture, and truck crops. Corn yields range from

about 15 to 30 bushels an acre. Lespedeza is the chief hay and pasture plant. Hay yields about 1 ton an acre, and the pasture is generally of fair quality. A few small areas are devoted to the production of wheat, oats, and barley. Yields of these crops are fair.

The content of chert in the surface soil, the occurrence of areas of this soil in narrow strips in association with soils poorly adapted to crops, and the presence of the semicemented cherty layer detract from the agricultural value of Roane gravelly loam. Its response to fertilization, however, is generally good, and it is adapted to the production of a rather large number of crops even though yields are only moderate. It seems to be well adapted to the production of truck crops and tobacco. Where properly fertilized, moderately high yields of good to excellent quality tobacco are obtained. Alfalfa does not grow well on this soil.

Even though this soil is not extensive and occurs in small areas, it is important on many farms, as it occurs in sections where productive crop soils are scarce. The farmers in these sections depend to a great extent on Roane gravelly loam for growing vegetables, corn, hay, and pasture grasses.

POPE SERIES

The Pope soils are young well-drained soils that lie in the first bottoms of streams. Most of the alluvial material giving rise to these soils comes from uplands underlain by sandstone and shale; that is, uplands where Hartsells, Muskingum, Hector, Lehew, and Apison soils occur; although a small proportion of the alluvial material comes from uplands underlain by limestone. These soils are comparable in drainage condition to the Huntington soils, but they are lighter brown in color, lighter in texture, more acid in reaction, and less productive. Like the Huntington soils, they are subject to periodic flooding. The soils of the Pope series in Roane County are classified and mapped in three types, namely, Pope very fine sandy loam, Pope loamy fine sand, and Pope gravelly fine sandy loam. They cover a total area of 13,376 acres, or 5.5 percent of the county. They are adapted to crops but differ considerably in productivity, depending largely on the texture.

Pope very fine sandy loam.—Pope very fine sandy loam occurs in the first bottoms, and most of the alluvial material giving rise to this soil has come from uplands underlain by sandstone and shale, although a considerable part has come from uplands underlain by limestone. This soil has slow external drainage but excellent internal drainage. It is friable and easily penetrated by air, water, and roots. Tilth is good. The reaction is acid to strongly acid. The soil is subject to periodic flooding and is moderate in productivity. Organic matter is less abundant than in the Huntington soils. The land is nearly level.

This soil shows very little development. In most places the material, to a depth of 8 to 12 inches, is light-brown or grayish-brown loose and friable very fine sandy loam. This grades into material that is generally just a little heavier in texture and slightly lighter in color, in some places being brownish yellow, and it is also rather loose and very friable. This layer continues to a depth of about

30 inches, where it grades into friable material that is mottled with gray, yellow, and brown.

Included in this soil as mapped are a few areas where the soil varies somewhat from the typical soil. The areas along King Creek below Hopewell School and along Paint Rock Creek constitute a soil that contains more than the usual proportion of material originating in the uplands underlain by limestone. The soil mapped as Pope very fine sandy loam along these creeks is a little more productive than the typical soil. Along Indian Creek south of Oliver Springs, along the Clinch River in the vicinity of Gallagher Ferry, and along the Emory River, the areas included with this soil are lighter textured than typical, being for the most part fine sandy loam. This lighter textured soil is a little less productive than Pope very fine sandy loam.

Pope very fine sandy loam occupies a fairly large total area. It is widely scattered over the county, occurring in the bottoms of both large and small streams. Some of the larger areas are along Indian and Poplar Creeks south of Oliver Springs and along the Clinch River in the vicinities of Gallagher Ferry and Kingston. Most of the areas are elongated in shape, and they differ considerably in size, some being only a few acres and some more than a hundred acres. A number of areas form narrow strips on the banks of the Tennessee River, and most of the islands in the river are occupied by this soil. Along the Tennessee River this soil is chiefly associated with Huntington silt loam, and along the Clinch River with Huntington silt loam and Pope loamy fine sand. Along the small streams it is associated with the Philo and Atkins soils of the bottoms lands and with the soils on the adjoining uplands, which in many places are Apison soils. In a few places it is associated with soils of the adjoining terraces.

Nearly all areas of Pope very fine sandy loam are cleared and used for crops, chiefly corn, but some are used for hay and pasture, and a small acreage is used for other crops common to the county. Corn yields less than on Huntington silt loam. Yields of 30 to 40 bushels of corn to the acre are frequently reported. Although yields of hay are less than on Huntington silt loam, they are moderate to fairly high on this Pope soil. Fairly good pastures can be produced.

Pope very fine sandy loam is one of the more desirable soils in the county. It is well drained, is nearly level, is easy to till, and is responsive to good management. It is deficient in lime and presumably in phosphate. It is also subject to overflow, and crops are subject to injury if unusually heavy rains occur during the growing season. If properly limed and fertilized, most of the common crops, including corn, clovers, grasses, cowpeas, and truck crops, yield well on this soil.

Pope loamy fine sand.—Pope loamy fine sand is similar to Pope fine sandy loam in drainage conditions, color, manner of occurrence, and source of material. It differs from Pope fine sandy loam chiefly in that it is lighter textured. This soil is loamy fine sand to a depth of 2 to 3 feet. Below this layer the material is rather variable, generally a little heavier in texture, and it contains some gray and yellow mottlings. Probably very little of the alluvial material of Pope loamy fine sand comes from uplands underlain by limestone. Most

of it comes from uplands underlain by sandstone. The color of Pope loamy fine sand averages a little lighter than that of Pope fine sandy loam. In consistence, Pope loamy fine sand is very loose and open. This soil is also subject to periodic flooding.

The total area of this soil is not large. The largest bodies are in the bottoms of the Emory and Little Emory Rivers, where this soil predominates, and other areas are along the Clinch River. Nearly all of the islands in the river are occupied by this soil. A few areas are along the Tennessee River, especially on Long Island. Most of the areas along the Clinch and Tennessee Rivers are narrow and elongated, whereas those along the Emory and Little Emory Rivers are comparatively wide, in many places occupying the entire width of the bottom land. This soil is associated with other soils in the bottom lands, soils on terrace lands, and soils in the uplands.

The associated soils along the Emory and Little Emory Rivers are mainly the Nolichucky and Waynesboro soils of the terraces and the Muskingum soils of the uplands.

Nearly all areas of this soil have been cleared and are used chiefly for the production of corn; but other crops, especially truck crops, are grown to some extent. Some areas that are lying idle are growing up to weeds and brush. Yields of crops in general are considerably lower than on Pope very fine sandy loam.

Although this land is nearly level, free or nearly free from stones and gravel, and easy to till, it is not good cropland, as the soil has low moisture-holding capacity and excessive internal drainage. As a result of these conditions, crops suffer readily from drought in dry weather. In addition this soil is low in lime and presumably in phosphate, and its organic matter is quickly depleted; but increased yields are obtained with proper fertilization. Truck crops probably would succeed fairly well.

Pope gravelly fine sandy loam.—Pope gravelly fine sandy loam is a somewhat mixed soil. It comprises the gravelly and stony soils in the bottom lands and consists of material that originated for the most part in the uplands underlain by sandstone and shale. This soil in most areas resembles Pope very fine sandy loam in color and drainage conditions, but areas were included in which the soil is intermediately drained. The characteristic feature of the gravelly soil is its large content of gravel and rounded sandstones. The texture of the soil material ranges from very fine sandy loam to loamy fine sand. The surface in most places is nearly level. Included with mapped areas of this soil are bodies that have considerable wash from coal mines and coal dumps, and in such places the soil material is dark and considerably mixed. Areas of this variation, which are of small extent, occur in the Cumberland Plateau section. Also included are a few small insignificant sand bars and areas of riverwash.

Most areas of Pope gravelly fine sandy loam border the streams flowing from the Cumberland Plateau section. Some of the largest bodies are in the vicinity of Rockwood, along Black Creek southwest of Rockwood, and in the vicinity of Elverton. The soil also occurs along some of the short streams and drains flowing from the sandstone and shale ridges. Most of the areas are narrow and follow

the stream courses. In some places this soil is associated with other soils of the bottom lands, chiefly other Pope soils but also Lindside and Atkins soils. In other places this soil is associated with the Muskingum soils, which lie on steep slopes flanking the narrow bottoms.

Owing to the fact that this soil occurs in small narrow strips, its use has been determined largely by the use of the associated soils. The greater part of this soil in the Cumberland Plateau section, where it is flanked by the uncropped Muskingum soils, is still in woods. Those areas associated with areas of other Pope soils or other soils adapted to crops are generally cleared and used for the production of corn or for pasture, but yields are low. Some areas are used for gardens in which the common vegetables are grown.

Owing to its content of gravel and stones and its comparatively low content of plant nutrients, this soil is not well adapted to crops, but most of it can be used for such a purpose. Increased yields and the successful production of a greater variety of crops follow proper applications of lime and phosphate.

PHILO SERIES

In drainage conditions, soils of the Philo series are intermediate between the well-drained Pope soils and the poorly drained Atkins soils. Like the Pope and Atkins soils, the Philo soils occur in the smooth bottom lands and are derived from alluvium, most of which originated in the uplands underlain by sandstone and shale. They are comparable to the Lindside soils in drainage but differ in source of material and reaction. The Philo soils in general are grayish brown or yellowish brown to a depth of 15 to 20 inches, below which the material is mottled. These soils are acid in reaction. They are of small extent in Roane County, and only one type is mapped—Philo very fine sandy loam.

Philo very fine sandy loam.—Philo very fine sandy loam occupies bottom land, where it is chiefly associated with the Pope and the Atkins soils. In drainage this soil is intermediate between the well-drained Pope soils and the poorly drained Atkins soils; but all these soils come from similar material, that is, alluvial material, most of which has originated in uplands underlain by sandstone and shale. Philo very fine sandy loam has a nearly level surface and is loose and friable, acid in reaction, and moderately productive.

This soil is grayish-brown or yellowish-brown loose and open very fine sandy loam to a depth ranging from 12 to 20 inches. Below this the material becomes mottled with gray, yellow, and rust brown; the texture in most places is just a little heavier; but the consistence is about the same. Gray and yellow mottlings increase with depth, and below a depth of 30 inches the color is largely a mixture of gray, blue, green, and yellow mottlings. Probably in most places a few rust-brown concretions are present in the soil, particularly in the upper part of the mottled material. In some places thin strata of either coarser textured or finer textured material occur in the soil, generally in the lower part. The surface soil in some places to a depth of about 8 inches is grayish brown and grades into

yellowish-brown heavy very fine sandy loam, which continues to the mottled material. In some places the mottled material comes within 8 inches of the surface. A few pieces of gravel occur throughout this soil.

Included with this soil as mapped are a few areas that have comparable drainage conditions and occupy the terraces instead of the bottom lands. The soil in most of these places shows more development than the typical Philo soil, and generally it is not susceptible to flooding.

Philo very fine sandy loam covers a small total area. It is widely distributed over the county and occurs in narrow elongated areas along the stream bottoms. Some of the largest bodies are mapped south of Oliver Springs along Indian Creek, below Paint Rock along Paint Rock Creek, and along Stamp Creek near Ponder Church. This soil is associated chiefly with the Pope and Atkins soils of the bottom lands and with many other soils on the terraces, colluvial lands, or uplands. The soils in the uplands with which this soil is most commonly associated are the Apison, Lehew, Muskingum, and Hector soils.

Probably nearly all of this soil is cleared, and it is used chiefly for corn, hay, and pasture. Corn is susceptible to injury during wet periods in the same manner as on the Lindside soils, and severe injury from wet conditions can be expected 2 or 3 years out of 10. When the rainfall is normal or below normal and well distributed, yields between 20 and 40 bushels of corn to the acre are obtained. This soil is well adapted to the production of hay, but the yields are a little lower than on Lindside silt loam. It is also well suited to pasture, although somewhat less productive of the desirable pasture plants than the Lindside soil. As this soil is subject to overflow, crops, particularly those planted annually, such as corn, are subject to injury from floods.

In suitability to different crops this soil is similar to Lindside silt loam, except for plants requiring considerable lime, such as clovers and the more desirable pasture grasses. Ordinarily, these plants grow better on Lindside silt loam. Probably the Philo soil is also deficient in phosphorus, and increased yields are obtained from the application of lime and phosphate, except in years when crops suffer from too wet conditions. The physical condition of this soil is such that it can easily be drained artificially where drainage is possible, and where artificially drained it is similar to Pope very fine sandy loam in productivity and adaptability.

ATKINS SERIES

The Atkins series includes light-colored poorly drained soils of the first bottoms consisting of materials most of which have been washed from uplands underlain by sandstone and acid shale. They are subject to frequent flooding. These soils differ from the Philo soils in that they are more poorly drained. They are comparable to the Melvin soils in drainage condition and color but differ in source of material and reaction. The Melvin soils consist of material washed chiefly from uplands underlain by limestone and are generally neutral or

slightly acid in reaction, whereas the Atkins soils consist of material washed chiefly from uplands underlain by sandstones and shales and are acid in reaction, generally strongly acid. The Atkins soils are chiefly associated with the Pope and Philo soils of the bottom lands. They are not extensive, and in this county only one type is mapped—Atkins very fine sandy loam.

Atkins very fine sandy loam.—Atkins very fine sandy loam generally is friable very fine sandy loam to a depth ranging from 6 to 10 inches. In most places this layer is light gray mottled with rust brown, yellow, blue, and various shades of gray. It grades into slightly heavier textured material that also is friable and similar in color, except that the proportion of gray and blue mottlings increases with depth. This material continues to a depth of more than 30 inches. This soil generally is strongly acid in reaction, has a nearly level surface, and is well suited only to pasture and forest.

Considerable variability occurs in this soil. In some areas the soil is lighter textured than indicated in the above description, and in others it is heavier textured. In a few places a rather compact subsoil layer has begun to develop. Gravel and rounded sandstone are abundant in some places. Along Black Creek southwest of Rockwood the soil mapped as Atkins very fine sandy loam has been covered with coal dust and refuse from the coal mines, and here it is nearly black to a depth ranging from 8 to 18 inches. This covering of coal-mine refuse does not seem to affect materially its use and productivity. Some areas included with this soil as mapped are swampy and are indicated on the map with marsh symbols.

This soil does not cover a large total area. It is widely scattered over the county in small narrow strips in the bottoms. Probably the largest bodies border Swan Pond Creek from 2 to 4 miles north of Kingston, and fairly large bodies border Black Creek in the vicinity of Glen Alice and White Creek in the vicinity of Eagle. This soil is associated chiefly with the Pope and Philo soils. It occupies the lower back bottoms and the old abandoned stream channels.

About 80 percent of the land is cleared. Oak, beech, poplar, sycamore, willow, and alder trees grow in the uncleared areas. The greater part of the cleared area is used for pasture. Some farmers attempt to grow corn, but the results are discouraging, except during the growing seasons when the rainfall is low. In the few small areas that are adequately drained by artificial means, yields of corn are fairly good. Where good management of the pastures is practiced and water-tolerant plants are grown, this soil supports fairly good pasture. As the soil is comparatively low in lime and presumably in phosphate, improved pastures are obtained from the application of these amendments. Owing to its poor drainage, both internally and externally, this soil is not suited to such crops as corn, small grains, truck, tobacco, fruit, or alfalfa. If this soil were drained by artificial means, corn, small grains, and truck crops would grow reasonably well, but the flood hazard would detract from its desirability for crops.

PRODUCTIVITY RATINGS AND LAND CLASSIFICATION

In table 6 the soils of Roane County are rated according to their productivity for the various crops grown in the county and are grouped according to their physical suitability for agricultural use.

The rating compares the productivity of each of the soils for each crop to a standard, namely, 100. This standard index represents the productivity, without the use of fertilizers and amendments, of the more productive soils of that region in the United States where the specified crop is most extensively grown. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. Soils given amendments, such as lime or commercial fertilizers, or unusually productive soils of small extent, may have a productivity index of more than 100 for some crops.

The following tabulation sets forth some of the acre yields that have been set up as standards of 100. They represent long-time average yields of crops of satisfactory quality.

Crop:		
Corn	bushels	50
Wheat	do	25
Oats	do	50
Barley	do	40
Apples	do	200
Potatoes	do	200
Sweetpotatoes	do	150
Timothy and clover	tons	2
Alfalfa	do	4
Lespedeza	do	1½
Burley tobacco	pounds	1,500
Sorghum	gallons of sirup	100
Pasture	cow-acre-days [1]	100

[1] Cow-acre-days is a term used to express the carrying capacity of pasture land. As used here, it is the product of the number of animal units carried per acre multiplied by the number of days the animals are grazed without injury to the pasture. For example, the soil type able to support one animal unit per acre for 360 days of the year rates 360, whereas another soil able to support one animal unit on 2 acres for 180 days of the year rates 90. Again, if 4 acres of pasture support 1 animal unit for 100 days, the rating is 25.

The soils of Roane County differ widely in productivity and measures of management. In the long run, the potential productivity of a soil under feasible farming practices is more significant than that intangible quality that has sometimes been called natural or inherent productivity. For this reason the productivity of the soils of Roane County is rated in three ways, according to different kinds of treatment (table 6, columns a, b, and c under each crop listed).

In column a, the indexes refer to expected yields without special practices to rehabilitate, maintain, or increase productivity. No manure or commercial fertilizers and no lime or other amendments are used, and no special effort is made in the selection and rotation of crops or to return organic matter to the soils.

In column b, the indexes refer to expected yields under present prevailing practices of soil management. The present general practice on the soils of the uplands is to make moderately heavy to heavy

TABLE 6.—*Productivity ratings of soils and*

Soil [1]	Crop productivity index [2] for—																				
	Corn			Wheat [3]			Oats [3]			Barley [3]			Tobacco [5] (burley)			Timothy and clover			Alfalfa		
	a [6]	b [7]	c [8]	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
Huntington silt loam	100	100	100	40	40	50	50	50	60	90	90	90	[9] 60	[9] 75	[9] 80	100	100	100	60	70	80
Dewey silt loam	60	70	100	70	80	110	65	75	100	55	65	90	70	100	120	70	80	100	80	95	110
Pope very fine sandy loam	70	70	90	40	40	50	45	45	60	60	60	70	[9] 50	[9] 65	[9] 75	80	80	100	50	60	70
Dewey silty clay loam	50	60	85	50	55	80	50	55	80	50	55	75	30	40	65	55	65	85	60	80	100
Talbott silty clay loam, smooth phase	45	55	80	50	60	80	50	55	70	45	55	75	50	70	85	50	65	80	50	65	85
Sequatchie very fine sandy loam	50	60	80	50	60	85	45	50	65	45	55	75	50	75	85	45	60	75	45	60	80
Allen very fine sandy loam	45	60	75	55	65	80	50	60	70	45	55	80	45	75	85	50	70	85	40	60	85
Lindside silt loam (undrained)	60	60	75	45	45	50	.	.	---	45	45	65	---	---	---	60	60	75	--	--	---
Greendale silt loam	45	55	75	40	50	70	35	40	55	40	45	70	40	65	80	50	65	80	35	45	70
Fullerton cherty silt loam, smooth phase.	30	45	75	35	45	65	20	30	45	30	40	55	40	65	80	30	45	60	20	35	55
Waynesboro very fine sandy loam	35	45	65	40	50	65	30	40	60	35	40	60	25	50	60	40	50	70	15	30	50
Hartsells very fine sandy loam	30	40	80	25	50	75	25	50	75	25	50	75	25	35	50	30	40	80	15	25	50
Wolftever silt loam	35	45	60	35	50	60	25	40	50	35	40	60	25	50	60	35	50	75	10	25	35
Wolftever silt loam, slope phase	30	40	55	30	45	60	25	35	45	30	35	55	20	45	55	30	45	75	10	25	35
Leadvale very fine sandy loam	30	40	60	35	50	60	25	35	45	25	40	50	25	50	60	30	45	55	15	25	40
Nolichucky very fine sandy loam	25	35	50	30	40	60	20	30	55	25	30	50	20	45	55	30	40	60	10	25	40
Sequatchie very fine sandy loam, slope phase.	35	50	70	40	50	60	35	40	50	35	40	60	40	60	75	45	55	75	30	45	65
Allen very fine sandy loam, slope phase.	35	50	70	45	55	75	40	50	65	35	45	70	40	65	75	45	65	80	30	50	80
Waynesboro very fine sandy loam, slope phase.	30	40	60	40	50	65	20	30	50	30	35	55	25	45	55	35	45	65	15	25	45
Talbott silty clay loam	30	40	60	40	55	65	30	40	50	30	40	55	30	50	60	35	50	65	25	35	45
Fullerton cherty silt loam	25	35	60	25	30	45	20	30	40	20	30	45	30	60	75	30	40	50	15	25	35
Dewey silty clay loam, hilly phase	35	45	65	35	40	65	35	45	70	30	40	60	20	40	50	50	60	75	40	60	75
Roane gravelly loam	30	35	60	30	40	50	20	30	40	25	30	50	25	45	55	35	45	60	15	25	40
Philo very fine sandy loam (undrained).	40	50	60	30	35	50	--	--	---	25	35	45	---	---	---	45	60	75	--	--	---
Colbert silt loam	30	40	60	35	45	60	20	30	45	30	40	55	25	50	60	35	45	60	20	30	50
Clarksville cherty silt loam, smooth phase.	25	30	50	25	35	60	15	25	35	25	30	50	20	35	60	25	35	50	10	20	30
Clarksville cherty silt loam	20	25	50	20	30	60	10	20	30	20	25	50	20	30	50	20	30	50	10	20	25
Fullerton cherty silty loam, eroded phase.	20	30	55	15	25	40	15	25	35	15	25	40	15	30	50	20	30	45	10	25	40
Pope loamy fine sand	25	35	55	25	30	45	15	25	35	15	25	40	15	30	50	20	30	50	10	30	60
Nolichucky very fine sandy loam, slope phase.	20	30	50	25	35	60	20	30	55	25	30	50	20	40	50	30	40	60	10	25	40
Apison very fine sandy loam	25	30	50	25	30	60	10	15	30	20	25	50	20	40	60	20	30	50	15	20	30
Hartsells very fine sandy loam, slope phase.	25	35	75	20	40	70	20	40	70	20	40	70	20	30	45	25	35	70	15	25	50
Jefferson gravelly fine sandy loam	25	30	45	25	30	50	15	25	40	20	25	40	20	30	45	20	30	40	15	20	30
Nolichucky very fine sandy loam, eroded phase.	10	20	45	15	25	55	10	20	50	15	20	45	10	25	45	15	25	55	10	20	35
Pope gravelly fine sandy loam	20	30	50	20	25	35	10	20	30	15	20	35	10	25	45	20	30	50	10	25	40
Jefferson gravelly fine sandy loam, slope phase.	20	25	40	20	25	45	10	20	35	15	20	35	15	25	45	15	25	40	15	20	30

See footnotes at end of table.

classification of land in Roane County, Tenn.

Crop productivity index [2] for—continued																								
Lespedeza			Sorghum [3] (sorgo)			Potatoes [3]			Sweet-potatoes [3]			Vegetables [4]			Apples [4]			Peaches [4]			Pasture [4]			Land classification [5]
a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	
100	100	100	[9]80	[9]90	[9]100	[9]50	[9]50	[9]50	60	70	80	70	70	70	---	---	---	---	---	---	150	150	150	First-class soils (good to excellent cropland).
80	90	110	[9]75	[9]75	[9]75	80	90	100	80	90	100	80	90	100	80	90	100	80	90	100	90	90	110	
80	80	100	70	80	90	[9]45	[9]45	[9]45	45	55	65	60	70	70	---	---	---	---	---	---	90	90	110	Second-class soils (fair to good cropland).
65	75	90	[9]65	[9]65	[9]75	65	75	90	65	75	90	65	70	80	70	75	90	70	75	85	70	70	110	
55	65	80	50	60	70	40	60	75	60	70	80	50	60	70	55	60	75	45	50	60	65	75	110	
50	65	80	55	70	80	50	65	80	65	75	85	60	70	80	65	75	80	60	70	85	65	70	100	
55	70	80	55	70	80	45	65	80	60	75	90	50	60	70	75	80	85	60	70	85	60	70	90	
65	65	80	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	90	90	110	
55	65	90	55	65	75	45	60	80	65	70	80	60	70	75	50	60	70	40	50	55	60	65	85	
35	50	80	40	50	70	35	45	70	45	60	75	60	70	80	40	50	60	60	65	80	40	50	75	
40	55	70	35	45	60	35	50	75	45	55	75	50	65	80	35	45	55	45	50	60	35	50	70	
55	75	80	30	50	75	40	60	100	40	55	90	40	60	90	30	40	50	50	60	70	30	50	80	
55	65	80	35	45	55	30	40	60	35	50	65	40	50	60	---	---	---	---	---	---	35	50	60	
55	65	80	30	40	50	25	35	55	30	45	60	35	45	55	---	---	---	---	---	---	35	50	60	
30	50	70	30	45	55	30	45	65	40	55	70	30	40	55	20	25	30	20	25	35	40	50	70	
35	45	60	30	40	55	30	45	70	40	50	70	45	60	80	35	40	60	40	55	60	30	45	65	
50	60	80	50	60	70	40	55	70	45	65	75	60	70	85	60	70	75	60	70	75	50	60	80	Third-class soils (poor to fair cropland).
50	65	75	45	60	70	35	55	70	50	65	80	40	50	60	65	70	75	55	65	80	55	65	80	
40	50	65	30	40	55	30	45	65	40	50	70	45	60	80	35	40	55	45	50	60	35	50	70	
35	50	65	45	55	65	30	40	50	45	55	65	30	40	50	45	50	60	40	45	50	40	45	70	
30	45	55	35	45	55	30	40	50	35	45	60	25	30	40	30	40	50	30	40	50	25	35	55	
50	60	80	[9]40	[9]50	[9]60	40	50	60	40	50	60	30	40	50	30	40	60	30	40	60	30	40	85	
35	45	65	40	50	60	30	40	55	40	50	70	40	50	60	---	---	---	---	---	---	40	45	70	
45	50	70	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50	60	85	
40	50	70	40	50	60	30	40	50	40	55	70	30	40	50	25	30	40	15	20	25	55	60	90	
30	40	50	30	45	55	30	40	50	35	45	50	30	45	65	30	40	50	35	40	45	25	30	45	
25	35	45	30	40	50	25	35	40	30	40	45	25	40	60	30	40	50	35	40	45	25	30	40	
20	35	50	25	35	50	15	25	40	20	30	50	15	20	30	20	30	45	20	30	45	15	20	50	
20	35	50	25	35	50	30	40	60	30	40	60	30	40	60	---	---	---	---	---	---	20	30	50	
35	45	60	30	40	55	30	40	65	40	50	70	40	60	80	35	40	55	40	55	60	30	45	65	
25	35	45	30	40	50	30	40	50	30	40	50	25	30	40	25	30	40	30	35	40	25	30	40	
45	60	70	40	55	65	35	55	90	35	45	80	30	50	75	25	35	45	40	50	60	25	45	75	
25	35	45	30	40	50	30	40	50	30	40	45	25	30	40	25	30	40	30	30	40	25	30	40	
25	30	55	15	25	50	15	30	55	20	35	60	25	45	70	25	30	55	25	40	55	15	30	60	
20	35	60	20	30	50	25	30	50	25	30	50	25	35	55	---	---	---	---	---	---	20	30	50	
25	35	45	25	35	45	25	35	45	25	35	40	20	25	40	25	30	40	30	35	40	25	30	40	

See footnotes at end of table.

TABLE 6.—*Productivity ratings of soils and*

Soil	Crop productivity index for—																				
	Corn			Wheat			Oats			Barley			Tobacco (burley)			Timothy and clover			Alfalfa		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
Upsbur silty clay loam, valley phase	40	45	50	50	55	60	35	40	45	35	40	45	[3]45	[3]50	[3]55	50	55	60	40	45	50
Melvin silt loam (undrained)	30	35	45	--	--	--	--	--	--	--	--	--	--	--	--	25	30	45	--	--	--
Dewey silty clay loam, steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Colbert silt loam, slope phase	30	40	50	30	40	50	25	35	50	25	30	45	20	30	45	30	40	50	20	30	35
Fullerton cherty silt loam, hilly phase	20	25	35	25	30	40	15	25	40	15	25	40	15	30	40	20	30	35	10	20	25
Colbert silty clay loam	20	30	45	25	30	40	20	30	45	15	25	40	10	20	30	20	30	35	15	25	30
Atkins very fine sandy loam (undrained).	20	20	30	--	--	--	--	--	--	--	--	--	--	--	--	20	25	35	--	--	--
Clarksville cherty silt loam, hilly phase.	20	25	35	20	30	35	10	20	30	15	25	35	10	25	35	15	20	30	10	15	20
Rolling stony land (Colbert and Talbott soil materials).	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Waynesboro very fine sandy loam, eroded hill phase.	15	20	40	15	25	50	10	20	40	15	20	45	10	25	45	15	25	50	10	20	35
Talbott silty clay loam, hilly phase	10	20	30	20	25	35	15	25	35	15	25	35	10	20	30	25	30	45	15	25	50
Armuchee silt loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	25	35	--	--	--
Apison very fine sandy loam, eroded phase.	10	15	30	10	15	30	10	15	20	10	15	20	10	15	20	10	20	30	--	--	--
Apison very fine sandy loam, eroded slope phase.	10	15	30	10	15	30	10	15	20	10	15	20	10	15	20	10	20	30	--	--	--
Fullerton cherty silt loam, eroded hilly phase.	10	20	30	20	25	35	15	25	35	15	25	35	15	25	35	20	25	35	15	20	25
Fullerton cherty silt loam, steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Clarksville cherty silt loam, eroded hilly phase.	10	20	30	15	20	30	10	20	30	10	20	30	10	20	30	15	20	30	10	15	20
Clarksville cherty silt loam, steep phase.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rough stony land (Talbott soil material).	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hector stony fine sandy loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lehew stony fine sandy loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Muskingum stony fine sandy loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rough gullied land (Fullerton soil material).	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rough gullied land (Apison soil material).	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rough stony land (Muskingum soil material).	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mine dumps	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

[1] Soils are listed in the approximate order of their general productivity under the prevailing current practices and their relative suitability for growing crops, pasture, or forest

[2] The soils of Roane County are given indexes that give the approximate average production of each crop in percent of the standard of reference. The standard represents the approximate average yield obtained without the use of fertilizer or amendments on the better soil types of significant extent in the regions in which this crop is most widely grown. Many of the ratings are the results of estimates, as supporting data are incomplete.

[3] Wheat, oats, barley, burley tobacco, sorghum, potatoes, and sweetpotatoes are rarely grown on soils of the first bottoms. For this reason yield data are extremely scarce, and the indexes in the table are arrived at inductively.

[4] These indexes for vegetables, apples, peaches, and pasture are largely comparative for the soil types of this and adjoining counties, as substantiating yield data are particularly scarce for these items. Although

classification of land in Roane County, Tenn.—Continued

Crop productivity index for—continued																								
Lespedeza			Sorghum (sorgo)			Potatoes			Sweetpotatoes			Vegetables			Apples			Peaches			Pasture			Land classification[4]
a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	
45	50	55	[9]40	[9]45	[9]50	25	30	35	25	30	35	30	35	40	45	50	55	40	45	50	70	75	85	Fourth-class soils (generally best suited to pasture).
15	25	30	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	60	70	80	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10	20	20	40	50	75	
40	50	60	30	40	45	20	30	35	25	30	35	30	35	40	35	40	50	15	20	25	40	50	60	
30	40	45	25	30	35	20	30	35	30	40	45	30	40	45	40	50	55	45	50	55	30	45	60	
30	40	50	25	35	40	20	30	35	25	30	35	25	30	35	35	40	50	15	20	25	30	40	55	
10	15	20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	40	45	60	
20	30	40	20	30	35	20	30	35	25	35	45	20	30	35	20	25	30	30	35	40	25	30	40	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	40	40	60	
25	30	55	15	25	50	15	25	35	15	25	35	25	35	45	25	30	40	20	30	40	15	30	60	
30	40	55	25	35	40	15	25	35	20	30	40	15	25	30	20	25	30	20	25	30	30	40	60	Fifth-class soils (generally best suited to forest).
25	35	40	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	35	40	50	
15	25	35	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	15	20	30	
15	25	35	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	15	20	30	
25	35	45	20	30	35	15	20	30	20	30	40	15	25	30	20	25	30	25	30	40	25	35	45	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	30	40	50	
20	30	40	15	25	30	15	20	30	20	30	40	15	25	30	15	20	30	25	30	40	20	30	40	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	25	25	35	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	30	30	40	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	15	15	30	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	20	20	30	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	15	15	30	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	20	20	50	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10	10	30	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	

not based on quantitative yield data or used strictly in reference to the standards, it is believed they are fairly comparable.

[4] This is a grouping of soil types and phases according to their relative physical use adaptation. (For further details see p. 95.)

[6] These indexes refer to yields commonly obtained without the use of manure, amendments, or beneficial crop rotation. (For further details see p. 89.)

[7] These indexes refer to yields obtained under commonest practices of management. (For further details see p. 89.)

[8] These indexes refer to yields that may be expected under the best practices of management. (For further details see p. 94.)

[9] The quality of these crops is relatively somewhat inferior, taking the average of the county as a standard.

NOTE.—Absence of indexes indicates that the crop is not commonly grown because of poor adaptation.

applications of complete commercial fertilizers for tobacco and vegetables, and light applications, or on some farms no application, for corn and small grains to be followed by hay crops. Phosphate alone or phosphate and potash are frequently applied to land used for corn and small grains. Lime is used on the uplands by some of the farmers, and the quantity of lime and phosphate used is rapidly increasing. Neither terracing nor contour tillage is a common practice. Crops are rotated, but neither the selection nor the rotation of crops is well adjusted to soil needs, generally speaking. On the soils of the bottom lands the prevailing practices for many crops are the same as those shown in column a, although land used for some crops, such as tobacco and vegetables, is fertilized.

In column c, the indexes refer to yields that may be expected under the best practices of soil management. Little of the land is being managed in this way, and the indexes in this column are largely estimates. Although accurate or mathematical data are not sufficient to support adequately these indexes, it is hoped that by comparing these with the indexes of columns a and b the relative responses of each soil to practices of management will be brought out. The term "best practices of management" refers to the choice and rotation of crops, the use of commercial fertilizers, lime, and manure, proper tillage methods, the return of organic matter to the soil, and mechanical control of water and erosion where necessary, carried on toward the end of maintaining and increasing soil productivity but not to an extent that would make farming unprofitable. On some of the fertile soils of the first bottoms, such as Huntington silt loam, the best feasible practices for several crops are the same as the prevailing practices; in fact, the more intensive farming practices produce little response in the way of increased yields, and the indexes in columns a, b, and c are identical.

The soils are listed in the table in what is thought to be the approximate order of their general adaptability to the important crops of the present agriculture under current practices. For lack of more definite data, this has been done chiefly on the basis of information acquired through field observation, local literature, and consultations with farmers in the county and with competent agricultural specialists in the State.

Factors influencing the productivity of land are mainly climate, soil (including drainage and relief), and management. Crop yields over a long period of years furnish the best available summation of those factors contributing to productivity, and they are used wherever available. In Roane County most of the productivity ratings are based largely on observations, interviews, local available literature, and local expert advice. Because of a lack of definite information and yield data by soil types in some instances, however, the indexes in this table represent inductive estimates rather than established yields. This is especially true of the indexes for sorghum, potatoes, sweetpotatoes, vegetables, apples, and peaches.

Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The tables give a characterization to the productivity of individual soil types. They cannot picture the total quantitative production of crops by soil areas with-

out the additional knowledge of the acreage of the individual soil types devoted to each of the specified crops.

Economic considerations play no part in determining the productivity indexes, so the latter cannot be interpreted directly into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land.

Only ratings for the unprotected conditions from flooding are given to the soils of the flood plains, as no areas are definitely protected by dikes or levees. As these floods usually occur in the winter and early spring, they affect only the winter crops to any great extent.

In the column headed "Land classification," the soil types, phases, and miscellaneous land types are grouped, according to their physical suitability for producing crops, grasses, or trees, in five classes: First-class soils, Second-class soils, Third-class soils, Fourth-class soils, and Fifth-class soils.

This is not a classification of soils as to their present use but rather as to their general suitability for agricultural uses. In general, under present agricultural and economic conditions, First-class soils constitute good to excellent cropland; Second-class soils, fair to good cropland; Third-class soils, poor to fair cropland; Fourth-class soils, land best suited to pasture but used in places for crops even though rather poorly adapted; and Fifth-class soils, land best suited to forest, though used in places for crops and pasture. It should be understood that the soils of the first three classes are in general capable of producing a good growth of grasses and trees as well as of field crops.

This grouping is not to be taken as a set of recommendations for land use on specific pieces of land or on individual farms, as a number of other factors besides soil characteristics enter in to determine the best use of the land. Among these are the location, extent, and pattern of distribution of the various soil types; crop prices and production costs; and the needs, preferences, abilities, and financial condition of the farm operators.

This classification is based on the physical characteristics of the soils or land. The soils of Roane County differ widely in character and consequently in use capabilities and requirements of management. These significant soil characteristics—internal and external—include depth, texture, structure, consistence, quantity, and character of organic matter, content of plant nutrients, reaction (degree of acidity or alkalinity), drainage, moisture-holding capacity, erosion, stoniness, and slope, or lay of the land. These soil features influence land use and soil management through their effects on productivity,[7] workability,[8] and conservation;[9] in other words, through their combined effect on the yields of crops and on the cost (in fertilizer, labor, machinery, power, etc.) of producing those yields and conserving the soil; and it is on considerations of productivity, workability, and problems associated with conservation that the five groups or classes of soils are based.

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[7] Productivity as used here refers to the capacity of the soils to produce crops, grasses, or trees under prevailing or other defined soil management practices.

[8] Workability refers to the ease of tillage, harvesting, and other field operations.

[9] Conservation refers to the maintenance of productivity and workability through saving the soil material and the supply of plant nutrients in the soil.

A good soil for crop production is very productive, is easily worked, and is capable of being conserved with minimum effort. A soil with such an ideal combination of features is rare. Almost all of the soil types and phases in Roane County fall short of this ideal, but they differ widely in the degree of such shortcoming. It is on this basis that they are placed in five groups or classes, for convenience in discussing their relationship to agriculture. These, in the order of their desirability, are, as previously mentioned, First-class soils, Second-class soils, Third-class soils, Fourth-class soils, and Fifth-class soils.

Although the soils of no one class are ideal for the production of plants, the soils of the First class more nearly approach the ideal than do those of the Second class. Likewise, the soils of each succeeding class are farther from the ideal than those of the preceding group. Therefore, the soils of the Fifth class are in general less productive, less easily worked, and more difficult to conserve than are the soils of any of the preceding groups.

This grouping of the soils according to their productivity, workability, and problem of conservation is shown in table 6. The grouping is also shown on the accompanying soil map.

FIRST-CLASS SOILS

In Roane County only two soils are included in the group of First-class soils, namely, Dewey silt loam and Huntington silt loam. These cover only 4,736 acres, or about 2 percent of the county. Although these soils differ greatly in profile characteristics, they are similar in regard to productivity, workability, and requirements for conservation. These soils are relatively well supplied with plant nutrients, although they differ somewhat in this respect. Both soils are well drained, yet their physical properties are such that moisture is retained well, tending to insure an equable supply for the growth of plants; that is, the physical character of these soils helps growing crops to resist extreme wet or dry weather conditions. Tilth is favorable, and the soils may be tilled under a comparatively wide range in moisture content. Organic matter is comparatively abundant. The fact that most of the organic matter has become an integral part of the soil shows that their character favors the humifying processes. The physical properties of these soils favor circulation of air and moisture, and roots freely penetrate all parts of the subsoil.

Neither of these soils is characterized by any important adverse external soil or land condition; that is, stones are practically absent, the slope, or lay of the land, is favorable to soil conservation and cultural operations, and severe erosion has not been and is not likely to be a problem. To summarize, these soils have a comparatively high natural fertility, favorable working qualities, and simple problems of conservation—both for the continued fertility of the soil and for the soil material itself. No detrimental characteristic, such as poverty of organic matter and plant nutrients or adverse conditions of texture, structure, consistence, erosion, stoniness, or moisture, is prominent in either of these soils; and both are well adapted to most of the exacting and intensive crops of the locality.

SECOND-CLASS SOILS

As compared with the First-class soils, the Second-class soils are characterized by one or more of the following qualities: Lower productivity, more difficult workability, or greater problems of conservation. The Second-class soils differ one from another in a number of respects, but they are all considered fairly well adapted to the production of crops. Each soil of this group partakes of one or more detrimental or unfavorable characteristics and conditions, such as natural poverty of plant nutrients, scarcity of organic matter, imperfect drainage, unfavorable physical properties, or injurious degree of stoniness and erosion. The detrimental effect of some one or some combination of such undesirable characteristics on the productivity or suitability for cultivation of each of these soils is greater than for either soil of the First class, but less than that of any soil in the Third class. The Second-class soils are moderately productive of most of the crops commonly grown. Their physical properties are moderately favorable to tillage and normal circulation and retention of moisture. None of these soils has pronounced relief, and none is extremely stony or severely eroded; that is, these soils are moderately productive, have moderately favorable features affecting workability, and can be conserved by common practices of management. In short, they are all reasonably well adapted to most of the important crops of the county.

A total of 14 types and phases are classified as Second-class soils. Their total area is 24,128 acres, or about 10 percent of the county's area.

THIRD-CLASS SOILS

As compared with the Second-class soils, the Third-class soils are characterized by more adverse conditions in regard to one or more of the following factors: Workability, productivity, and problems of conservation. On the other hand, they are characterized by less adverse conditions of one or more of these factors than the Fourth-class soils. In the Third-class soils one or more of the following undesirable features are rather prominent: Poverty of plant nutrients, poverty of organic matter, undesirable physical properties, shallowness to bedrock, strong slope, stoniness, erosion, and unfavorable drainage. These detrimental features limit the use capabilities and complicate the management requirements of these soils.

Classified on the basis of internal and external characteristics, the Third-class soils include types and phases of the following series: Colbert, Talbott, Dewey, Fullerton, Clarksville, Apison, Hartsells, Allen, Jefferson, Nolichucky, Waynesboro, Sequatchie, Pope, Philo, and Roane. Their total area is 56,000 acres, or about 23 percent of the county's area.

FOURTH-CLASS SOILS

None of the soils previously discussed in this section is characterized by extreme development of any of those soil or land features that are unfavorable for the growth of crops; whereas the Fourth- and Fifth-class soils are characterized by extremely adverse conditions of workability or erodibility, so that they are not adapted to the

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production of cultivated crops, although they are moderately productive of pasture grasses and are used extensively for pasture. They have at least moderate natural fertility and moderate to high moisture content. Aside from these common features, they differ widely from one another in kind, number, combination, and extent of development of both internal and external soil characteristics. Included in this class are nine types and phases of the Colbert, Dewey, Fullerton, Clarksville, Upshur, Waynesboro, Melvin, and Atkins series and one miscellaneous land type. Fourth-class soils occupy 49,600 acres or about 20 percent of the area of the county.

FIFTH-CLASS SOILS

Like the Fourth-class soils, each of the Fifth-class soils is characterized by one or more very unfavorable or detrimental soil or land features that make them physically unsuited for growing cultivated crops. In addition, they are not, for the most part, physically adapted to pasture. All the soils of this class are characterized by one or more of the following undesirable features: Hilly or steep relief, high content of loose stones, numerous bedrock outcrops, severe erosion, low content of available plant nutrients, excessive drainage, and strong or very strong acid reaction. Owing to the undesirable characteristics manifested by soils of this class, their natural fertility is generally low, their tillage is either impossible or very difficult, and their conservation, if cultivation were attempted, would be extremely difficult. Although forest trees grow more slowly on these soils than on the soils of any other group in the county, they may be thought of as being physically adapted to forest in the broad sense that implies the use of land that best serves conditions as they exist. It is clearly understood, however, that factors arising from other existing conditions, either of the locality or of the individual farm unit, may require the utilization of some of this land for crops and pasture, although in its natural condition it is very poorly adapted to such uses.

Although these Fifth-class soils are characterized by features that disqualify them for any of the preceding classes, they differ from one another in many respects, such as color, texture, depth over bedrock, and character of parent material. On the basis of such differences, they are separated into soil types and miscellaneous land types; and as these units possess individuality, it is reasonable to assume that as individuals they exhibit important differences as regards forestry.

Included in this group of Fifth-class soils are 11 types and phases of the Talbott, Fullerton, Clarksville, Armuchee, Apison, Lehew, Muskingum, and Hector series and 5 miscellaneous land types. These soils occupy 108,736 acres, or about 45 percent of the county.

GENERALIZED LAND CLASSIFICATION MAP

The soil map of Roane County shows graphically the extent and distribution of the 56 soil types and phases and 6 miscellaneous land types that cover the county. As these 62 units of mapping are differentiated on a basis including both internal and external soil characteristics significant to land use, each unit possesses individuality

significant to land-use capabilities and management requirements for agricultural purposes. With such detailed physical land data logically assembled and graphically recorded in the form of a soil map, a considerable number of land classification maps can be interpreted or lifted readily from the soil map. Figure 3 is an example of such a land classification map interpreted from the soil map. This land classification map is of necessity somewhat generalized because of its small scale. Figure 4 shows the same classification of land except that it is more generalized.

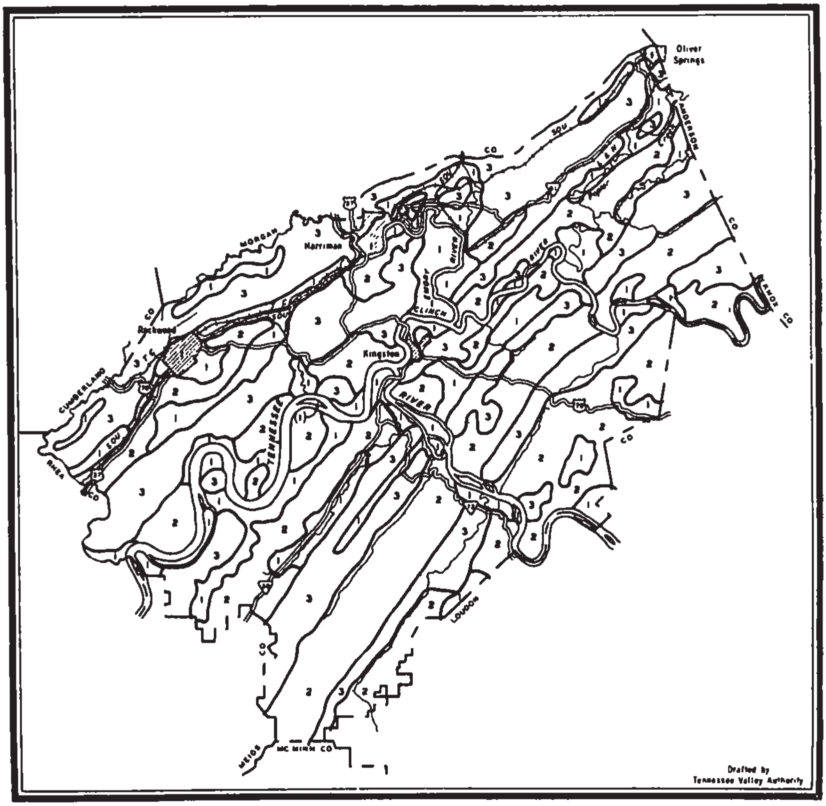

FIGURE 3.—Sketch map showing a general classification of the land in Roane County, Tenn.: Land type 1, predominantly soils characterized by favorable productivity and workability and minimum problems of conservation; land type 2, predominantly soils characterized by moderate to high productivity but unfavorable conditions of workability, problems of conservation, or both; land type 3, predominantly soils characterized by low to very low productivity and unfavorable conditions of workability, very difficult problems of conservation, or both.

Figures 3 and 4 show the land of Roane County divided into three types, namely, land type 1, land type 2, and land type 3. These three land types are differentiated chiefly on the basis of productivity, workability, and problems of conservation. Land type 1 consists predominantly of soils characterized by relatively favorable productivity and workability and minimum problems of conservation. Land

type 2 consists predominantly of soils characterized by moderate to high productivity but unfavorable conditions of workability, problems of conservation, or both. Land type 3 consists predominantly of soils of low to very low productivity and unfavorable conditions of workability, very difficult problems of conservation, or both.

Land type 1 is composed chiefly of First-class, Second-class, and Third-class soils, previously discussed. Although small areas of Fourth-class and Fifth-class soils necessarily are included because of the generalized character of the map, probably more than 90 percent of the land in this type is physically adapted to crops requiring tillage.

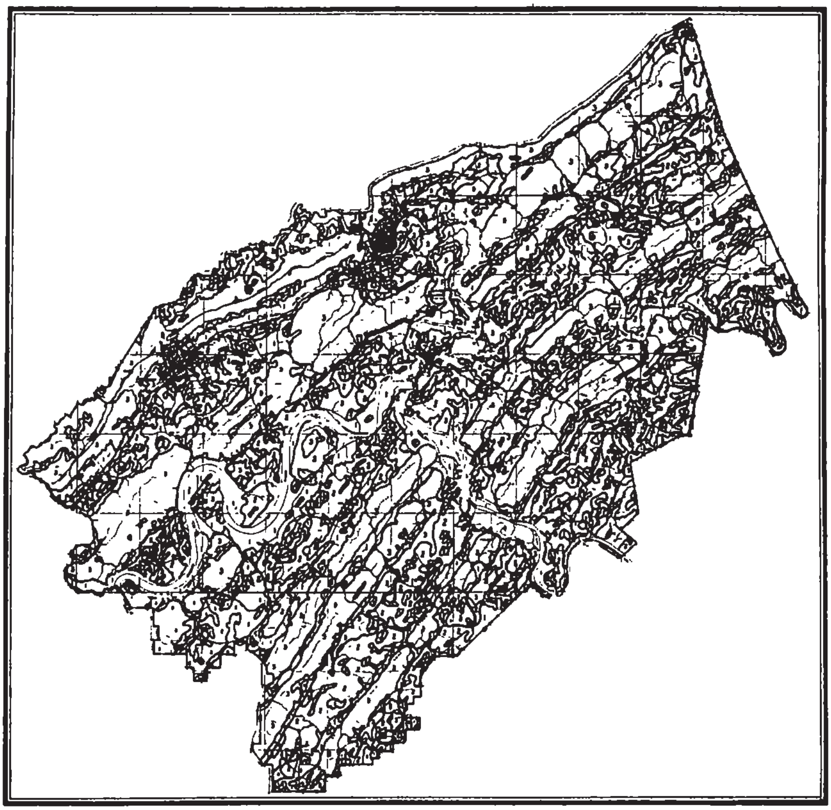

FIGURE 4.—Sketch map showing the same classification of land as in figure 3 but less generalized: Land type 1, predominantly soils characterized by favorable productivity and workability and minimum problems of conservation; land type 2, predominantly soils characterized by moderate to high productivity but unfavorable conditions of workability, problems of conservation, or both; land type 3, predominantly soils characterized by low to very low productivity and unfavorable conditions of workability, very difficult problems of conservation, or both.

It is estimated that about 35 percent of the total area of the county is included in this type. The greater part of the corn, wheat, tobacco, and alfalfa is produced on this land type.

Land type 2 consists predominantly of Fourth-class soils, according to the soil grouping discussed previously, and represents about 20

percent of the total area of the county. About one-half of the land is being used for pasture, and it may be advisable, so far as the physical character of the land is concerned, to devote considerably more to that use in places where such use is consistent with practical farm management. Probably 25 to 30 percent of this land type is now in forest, most of which is second growth. A considerable part of this land probably is physically adapted to permanent pasture. About 25 percent of the land type is now under cultivation, and some of it is not well adapted physically to crops requiring tillage.

Land type 3 consists chiefly of Fifth-class soils previously described. The greater part of this land is in forest, and the physical character of most of it suggests this use under present conditions. Although a number of exceptions are included because of the generalized character of the map, this land type consists chiefly of soils low in fertility, and most of it occupies strong and rugged relief. A part of the land is severely gullied, and a part is extremely stony. This land type occupies about 45 percent of the county.

Boundary lines separating these land types are generalized, and especially so in figure 4. Within each land type as indicated on the map, small areas conform to the other two land types. This applies particularly to land type 1, more than 5 percent of which may be composed of isolated areas consisting largely of soils that conform to land types 2 and 3. Similar inclusions, but to less extent, are in land type 2. Land type 3, however, includes little land physically adapted to pasture or cultivated crops.

The foregoing discussion is concerned with the predominant physical character prevailing in the respective areas delineated. These maps are not to be taken as a recommendation for land use, as factors other than those of the physical character of the land are involved in such recommendations.

LAND USES AND SOIL MANAGEMENT

In Roane County the land is used chiefly for the production of crops, pastures, and forests. Between 55 and 65 percent of the land in the county is used for forest, and the rest is used chiefly for crops and pasture. A small total acreage is devoted to urban development and mining.

According to the 1935 United States farm census report, 191,179 acres, or 78.6 percent of the county, was in farms in 1934, the average size of farm being 103.7 acres. According to this census report, 17,629 acres were used for the production of hay and forage and 46,134 acres for pasture in 1934. According to the same report, in 1934 the cropland harvested was 47,358 acres, crops were a failure on 425 acres, and cropland idle or fallow amounted to 14,982 acres, a total of 62,765 acres of cropland. Corn has been and still is the chief crop; in 1934 it was grown on 19,963 acres. The total acreage used for wheat in the same year was only 2,474 acres, and the total acreage of oats, barley, rye, tobacco, potatoes, and sweetpotatoes was only 1,676 acres. According to the United States census report, 6,162 acres were used for the production of fruit, mainly peaches, in 1929.

As brought out in the section on Agriculture, the present management of the soils used for crops differs considerably. Some of these differences in management arise from differences in soils, but

the full significance of differences in management requirements of the various soils is not generally appreciated. Although a systematic rotation of crops is not practiced on all farms, it is practiced on a rather large proportion of them. Probably the most common rotation is corn 1 year, small grain 1 year, and hay or pasture 1 or 2 years. The small grain is chiefly winter wheat, but winter oats or winter barley are sometimes substituted for the wheat. The chief hay and pasture crop is lespedeza. The total acreage of legumes other than lespedeza is small, but some alfalfa, red clover, soybeans, and cowpeas are grown. One reason for this is that most of the soils are so low in lime and phosphate that lespedeza seems to be the only legume that will grow successfully without the application of these amendments.

The use of fertilizers has increased considerably in the last 50 years or more. Most of the fertilizers are used on land for corn, small grains, tobacco, potatoes, fruit, and truck crops. The more popular of the ready-mixed fertilizers are low-analysis mixtures, such as 0-10-4, 3-8-5, 2-9-4, 2-10-4, and 4-12-4. Phosphate fertilizers, mainly 16 percent superphosphate, are used for corn, wheat, oats, and hay crops. Lime, in addition, is frequently applied to the hay crops, particularly legumes. Some nitrate of soda is used for side dressing certain crops, chiefly corn. In general, fertilizers are applied chiefly according to what the needs of the crops are thought to be, and relatively little attention is given to differences in fertility levels of the soils being treated.

One of the basic agricultural problems in this county is that of bringing about proper adjustments in the uses and management of the land, particularly in regard to land used for crops and pasture (pl. 5, *A*). Although other factors are influential, the physical character of the land largely determines its use capabilities and the management requirements. In the agricultural expansion and development in the county considerable regard was given to the physical character of the land in choosing that to be cleared for crops and pasture. At present the great proportion of land physically suitable for crops is used for crops, much of that unsuitable for crops but suitable for pasture is used for pasture, and most of that physically unsuited to both crops and pasture but suitable for forest is used for forest (pl. 5, *B*).

In spite of this more or less general agreement between the broad uses of land and its physical suitability for use, examples of wrong land use are very numerous. More prevalent, however, are examples of unwise soil management. Ill-adjusted land use and poor soil management usually manifest themselves together, but examples of reasonably well adapted land use accompanied by poor soil management are common.

The present management of cropland is all too frequently ill adjusted to the soils. Symptoms of this condition are low yields of crops on many soils, low carrying capacity and poor quality of many of the pastures, the eroded condition of many of the soils, and the rather large proportion of idle or fallow cropland.

Without doubt, the productivity of most of the soils used for crops and pasture can be significantly increased and maintained at a considerably higher level by exercising proper management. Of particular importance is the choice of crops for rotations, the length

A, Valley in Roane County typical of those in eastern Tennessee. Note attempt of farmers to adjust their use of the land to a complex pattern of different soils. *B*, Soil use on this farm is fairly well adapted to the natural capabilities of the soils: Foreground, Pope and Leadvale soils, naturally suited to crops; middleground, Apison very fine sandy loam, a shallow soil over shale, so severely eroded that it is very poorly suited to crops, although fairly productive of pasture grasses under good management, and wooded background, predominantly Lehew soils, suited only to forest.

of rotations, and the application of amendments. In this regard it is important to remember that the soil types and phases possess a certain individuality in regard to management requirements; that is, they differ in such features as the quantities of lime, phosphorus, potash, and nitrogen required and in the length of the rotation required. The management requirements of each soil considered suitable for crops and pastures are treated under the soil type and phase discussions in the section on Soils.

Further information pertaining to crops and fertilizers is contained in the following publications:

Tennessee Agricultural Experiment Station Bulletins Nos. 112, The Small Grains in Tennessee; 126, Varieties of Corn and Their Adaptability to Different Soils; 136, The Oat Crop (revised); 149, Fertilizers and Manure for Corn; 154, Lespedeza Sericea; and 165, Clovers and Grasses for Hay and Pasture.

Tennessee Agricultural Experiment Station Circulars Nos. 9, Nitrogenous Fertilizer Materials; 10, A Select List of Varieties of Farm Crops (revised); 11, Rates and Dates of Planting for Tennessee Farm and Garden Crops (revised); 12, Alfalfa and Sweet Clover Culture; 27, A Select List of Varieties of Vegetables (revised); 30, Three New Varieties of Lespedeza; 34, Increasing the Profits From Phosphates; 45, Balbo Rye; 49, Korean Lespedeza; 52, Rye for Pasture and Seed in Tennessee; and 60, Fertilizers for Tennessee Soils.

Tennessee Agricultural Experiment Station Information Circular 14, Austrian Winter Peas (mimeographed).

Adjusting the use and managment of the land is no simple task. Adjustments must necessarily be made through the individual farms, and the ability of the farmers to make desirable adjustments is limited by a number of factors, many of which are beyond his control. The goal should be, however, to achieve the greatest harmony between the land and the people who earn their living from it.

WATER CONTROL ON THE LAND

Water control on the land consists of practices having to do with regulation of run-off and with the maintenance of favorable soil-moisture conditions. These practices include (1) control of run-off, (2) artificial drainage, (3) irrigation, and (4) protection from floods. In this county only the control of run-off and artificial drainage are important at present. Protection of bottom lands from floods by means of dikes or similar devices is but little practiced. Irrigation is of no importance at present, although doubtless it would increase production of crops in dry seasons. Its use to supplement rainfall might prove economically feasible at times, especially on gardens and on small areas of high-priced crops, such as vegetables, fruits, and tobacco.

Control of run-off is more important than artificial drainage in this county, at least as regards the acreage affected. The problem of the control of run-off exists in some degree on most of the cleared uplands and terraces, that is, about 75,000 acres, or about 31 percent of the total area of the county; whereas only about 5,360 acres, or a little more than 2 percent of the total area of the county, need artificial drainage to establish suitable moisture conditions for tilled crops. The soils on which run-off needs to be controlled are distributed throughout the uplands and terraces. The soils on which drainage needs to be provided are restricted to stream flood plains and flat or depressed areas on the uplands and terraces, and include the Atkins,

Melvin, Philo, and Lindside soils. The Philo and Lindside soils can be and are being used for crops without artificial drainage, but injury to crops from wet conditions occurs occasionally and is to be expected during periods of high rainfall during the growing season.

Both control of run-off and artificial drainage are essential to the welfare of farming in this county. Adequate control of run-off would have a far-reaching effect on soil conservation and crop production, particularly as it is needed on at least three-fourths of the cleared land. Artificial drainage would greatly broaden the adaptability of the Atkins and Melvin soils. These soils, in their natural state of drainage, are suitable only for pasture and forest, but, if artificially drained, practically all of them would be well adapted to growing corn, hay, and most of the other important crops.

CONTROL OF RUN-OFF

The term "control of run-off," as used here, refers to prevention of rapid and excessive flow of water from the fields, pastures, and forest where it falls. A certain amount of run-off takes place on sloping land even under a dense cover of vegetation, but when such land is cleared and cultivated or otherwise stripped of its protective covering it is subject to much more rapid run-off, with loss of moisture needed by crops and loss of soil by erosion.

Among the beneficial effects of control of run-off are (1) a more uniform and adequate supply of moisture for growing crops; (2) control of soil erosion; (3) improved tillage conditions, particularly in dry periods; (4) better conditions for biological (bacterial) activity; and (5) improved conditions for the formation of humus. Not only is control of erosion a direct result of water control, but the other beneficial effects make further conservation and control of water easier.

Most of the excessive run-off and erosion that have taken place in this county have been due to unfortunate choice of land for crop growing, to the use of tillage practices not well adapted to the character of soil or the lay of the land, or to overgrazing or other practices that leave sloping lands unprotected. The remedies are proper land use and good soil management. Land with excessive slopes or otherwise subject to very rapid run-off should be used, as far as practicable, for forests; land with somewhat less slope may be safely used for pasture; land with still less slope may be used largely for close-growing crops; and only rather gently sloping land, where run-off is not rapid, should be used frequently for intertilled crops. In general, crop rotations should be so adjusted that the more sloping land under cultivation will be in grasses, legumes, and cover crops as much of the time as possible. The use of lime, manure, and fertilizers to increase the fertility of the soils and promote vigorous growth of vegetation is important. If steep erodible land is to be cultivated, certain mechanical means of controlling run-off and erosion should be used, including contour tillage, terracing, and strip cropping. More complete discussions of land use and soil management are included in the section on Land Uses and Soil Management.

DRAINAGE

The discussion of drainage here is restricted to those soils whose natural drainage is inadequate for crop use. A total of 5,360 acres in the county is in need of artificial drainage. About one-half of this is definitely too poorly drained in the natural state for crop use, but the remaining one-half is sufficiently drained to allow the growth of some intertilled crop, such as corn, although these soils are inadequately drained and artificial drainage would materially improve their productivity and broaden their adaptability. The Melvin and Atkins soils are in great need of drainage, and, although the Philo and Lindside soils can be used for certain crops, artificial drainage would greatly improve them. The soils of the two degrees of drainage are intimately associated geographically, have similar distribution over the county, and occur in bottom lands along the streams. If adequately drained, the Lindside and Melvin soils would be more productive than the Philo and Atkins soils.

The question as to the feasibility or advisability of draining these soils is not the same on the entire 5,360 acres, as the practicability of installing artificial drainage differs greatly from place to place, depending on a number of factors. Artificial drainage has been established in a small proportion of them. Owing to the friable consistence and permeable character of these soils, they would drain well by artificial means in areas where drainage is possible. No adequate studies have been made as to the engineering problems involved, and for this reason no discussion of this problem is attempted. It might be added, however, that many areas of poorly drained soils are underlain by shale and many areas are in the low back bottoms away from the stream channels.

FORESTS[10]

The first time that white men ever beheld the lofty trees in this part of the Tennessee Valley seems to have been shortly before 1750 (*18*). At the time of the earliest white settlements, most of the land was covered with forests. In some areas the trees evidently were widely spaced, with grass growing between them, which provided good grazing for the livestock. This condition most likely existed on some of the hills and ridges, especially on their southern slopes, and in some of the bottom lands, except on the stream banks and in marshy places. Early travelers mention "a fine chestnut woods" from the Clinch River to Little Cane and Big Cane Creeks, "a half mile of marshy land" at the creeks, "barren hills where only bushes and grass grow with now and then a little tree" from the creeks to the foot of the Cumberland Mountains; and "tall spruce and white pine trees" on the banks of Mammy's Creek (*18*). The area extending about 18 miles east of Kingston was an overmature forest with trees in some places 20 to 30 yards apart and with grass growing between them (*11*). The banks of the Tennessee and Clinch Rivers were covered with trees and brush almost continuously (*15*), willows being very common.

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[10] This section was written by G. B. Shivery, extension forester of the University of Tennessee.

Reports concerning conditions in the latter half of the nineteenth century include such expressions as "well wooded," "fine timber," and "heavily timbered." The hills and ridges supported heavy stands of large trees, with oaks predominating, but also much poplar and walnut. East of Kingston there was considerable pine (*8*). When Harriman was established in 1890, the most that could be seen in any direction was forest trees (*1*).

At first the demands of settlers on the forests were small, mainly to supply the limited needs for houses, furniture, fences, implements, and fuel. The waste in clearing was much greater than legitimate use, and forest fires were more destructive than either. Increased local demand was brought about by the use of charcoal for iron smelting (*17*) (first furnace constructed in 1828), the inauguration of regular steam navigation on the upper Tennessee River in 1835 (*6*), and the use of cross ties and other construction material when work started in 1873 on the first railroad in the country (*10*).

Until about the end of the eighteenth century, practically no forest products were shipped from the county, except perhaps a few logs that were floated down the rivers. What might be considered the beginning of lumber exportation was the starting, in a small way, of navigation on the upper Tennessee River in 1797 (*6*). This river traffic increased considerably after the advent of steam navigation and reached its greatest proportions about 1900. The estimated value of commercial freight in forest products on the Tennessee River above Chattanooga for that year was $1,099,899 (*16, p. 2431*), and it is logical to conclude that Roane County was a principal contributor. Added to this river commerce was shipment by rail after the first railroad began operation in 1880 (*3*). In fact, the location of wood-using plants at Harriman at present is largely the result of its favorable railroad connections. The last raft from Roane County was floated from the Clinch River over the Tennessee River to Chattanooga in 1927.

About 60 percent of the county is in forest, and the distribution of the forest land is largely an expression of soils and soil conditions, such as low fertility, stoniness, chertiness, and hilly and steep relief. Forest growth is most common on Muskingum stony fine sandy loam, rough stony land (Muskingum soil material), Lehew stony fine sandy loam, Hector stony fine sandy loam, and the soils of the hilly and steep phases of the Fullerton and Clarksville series. Less common are forests on Hartsells, Talbott, Colbert, and Jefferson soils. Rather large belts of forest land are on the ridges in the great valley section of the county, including such ridges as Paint Rock, Walker, Hurricane, Riley, Bacon, Welcer, Dug, Copper, Chestnut, Black Oak, East Fork, Dickey, River, and the several Pine Ridges (see fig. 2, p. 3). The Cumberland escarpment and most of the Cumberland Plateau section of the county are also in forest.

As regards the character and composition of the forest, it is advisable to treat the county under four soil groupings, group 1 consisting of soils in the Cumberland Plateau section of the county, group 2 consisting of soils on the Cumberland escarpment, group 3 consisting of soils on the cherty dolomitic limestone ridges, and group 4 consisting of soils on the shale-sandstone ridges.

Group 1, comprising chiefly the Muskingum and Hartsells soils, supported, prior to heavy cutting for cross ties, principally oaks, including white oak, post oak, scarlet oak, black oak, southern red oak, chestnut oak, and blackjack oak. These soils also supported some pignut hickory, red maple, and tupelo or blackgum. White pine and hemlock grow along the streams, where the supply of moisture is ample and the climate is somewhat cooler.

Group 2 consists chiefly of rough stony land (Muskingum soil material). This land, which is droughty, supports chiefly Virginia pine, white hickory, southern red oak, sourwood, blackgum, and persimmon. On the north-facing slopes, which are cooler and less droughty, the trees are tuliptree (tulip poplar), basswood, black walnut, beech, and northern red oak.

Group 3, composed chiefly of soils of the hilly and steep phases of the Clarksville and Fullerton series, supports largely white oak, southern red oak, post oak, scarlet oak, blackjack oak, blackgum, shagbark hickory, dogwood, sourwood, dead chestnut, and white pine, and sweetgum is common in ravines. In general, these soils support timber trees of superior quality and more readily marketable species than do the soils of group 4. This is particularly true in regard to the conifers, which on the Clarksville and Fullerton soils are chiefly white pine, whereas on the Lehew, Hector, and Muskingum soils they are chiefly Virginia (scrub) pine.

Group 4, consisting chiefly of the Lehew, Hector, and Muskingum soils, support a forest growth chiefly of Virginia pine, sourwood, black oak, chestnut oak, blackgum, and pignut hickory. These trees are particularly dominant on the crests of the ridges. In depressions, ravines, and on north- and east-facing slopes the trees include tuliptree, sugar maple, northern red oak, dead chestnut, and a few other species in demand for market.

Redcedar is conspicuous on rolling stony land (Colbert and Talbott soil materials), rough stony land (Talbott soil material), and Talbott silty clay loam, hilly phase. Soils of the eroded phases of the Fullerton and Clarksville soils, where abandoned, seed naturally to shortleaf pine, except where the more prolific seed-producing Virginia pine is abundant in the general vicinity. Virginia pine occurs locally on abandoned areas of soils of the eroded phases of the Apison series.

According to the United States census data, 84,649 acres, or more than half of the total forested area, is owned as parts of farms, an average of 46 acres to the farm, which is about twice the average for the State as a whole. Woodland on farms in 1929 gave an average return of $2.32 an acre from the sale and home use of forest products. The average number of acres in woodland on farms has not decreased materially. According to the 1935 census, 44 percent of the farm land is now wooded, compared with 47 percent in 1910.

Two wholesale lumber plants in Harriman handle part of the output of small portable mills in adjoining counties, and a plant in this city extracts tannic acid from dead chestnut and manufactures the spent wood into fiberboard. During the winter of 1936–37, as many as 50 small mills were operating in the county, 16 in the fourth district alone. In 1912, 22 mills were reported, 2 of which,

located in Oakdale (Morgan County) and Rockwood, cut more than 1,000,000 board feet a year. The cut is largely second-growth shortleaf pine, which, as a rule, is sold green to any wholesaler who will buy. Overcutting is everywhere general, pine as small as 5 inches in diameter on the stump being cut into 2 by 4's.

The trees of commercial value in this county are yellow (shortleaf) pine, and mixed oak, some tuliptree, hickory, dead chestnut, beech, maple, and other hardwoods.

No growth of virgin timber remains, and the existing supply of merchantable timber is seriously depleted. Stands of pine reaching a minimum cutting size between periods of brisk demand are becoming less and less numerous, and they are becoming more and more difficult for the small country mills to locate. It is evident that the present drain on the forest resources is tremendous. In regard to the supply of dead chestnut trees it is estimated that at the present rate of cutting the supply will be exhausted in about 4 years. The supply of oaks and other hardwoods is not great, and furthermore, the oaks are generally of low grade. An outstanding impression obtained from a knowledge of forest conditions in this county is of the remarkable ability of cut-over land to recuperate and again support new tree growth reestablished by natural means. This situation is particularly true of native yellow (shortleaf) pine.

Although not so evident in late years, as recently as a decade ago it was a common sight to see fields that had been abandoned and had grown up to a dense growth of old-field (shortleaf) pine being cleared again and trees being cut that were too small for use as 2 by 4's. Had these stands been left, they would have attained a size for use as building material in a few years and provided a product, in the form of native pine lumber, that always finds ready sale.

The woodland is of two general types—cut-over hardwood land and second-growth pine thickets, the latter coming in on previously cropped and later eroded and abandoned land. Isolated tracts of farm woods are composed of a mixture of merchantable hardwood and pine timber intermingled with a sprinkling of saplings and poles of good species, approaching the typical all-age forest with its progression and distribution of ages and sizes. The cut-over hardwood land contains many cull trees that hinder the development of promising young trees by overtopping. Farm woodlands can be improved materially by using such inferior trees for fuel and other minor farm needs. Such improvement resolves itself into the systematic cutting and use of crooked trees, short bushy-crowned trees, unsound culls, slow growers, and poor species, and reserving the straight, tall, well-crowned trees, free from defects, for growth into final crop timber. An outlet of this character, entirely consistent with better forest practice, is the sale of peeled pulpwood to paper companies drawing from this territory. Such soft hardwoods as red maple (soft maple), blackgum, and sweetgum probably have their maximum utilization in this form. Along with them should be included crooked or otherwise undesirable poplar and basswood trees; but straight, sound, long-bodied trees of these species should be reserved for final crop trees.

The second-growth pine thickets are composed largely of young shortleaf pine, with Virginia pine on the drier and more unfavorable

sites. Shortleaf pine displays a remarkable ability to establish itself by natural seeding on areas where the mineral soil is exposed, provided seed trees are present and so spaced that the wind can disseminate the seed properly when the cones open in early fall. A higher percentage of potential crop trees and more rapid growth of the selected individuals are obtained by judicious thinning during early life after the height is attained in stands of this kind (pl. 4). The material removed can be sold as pine pulpwood in some localities. The best pulpwood is fairly uniform in growth, with a relatively high ratio of springwood to summerwood, brought about by successive light thinnings rather than a single heavy thinning. Many similar even-aged stands originating on moister sites with more humus in the soil are composed of a mixture of tuliptree, sweetgum, and red maple, which likewise can be thinned to advantage and utilized as peeled pulpwood, a practice that reserves the finer trees for increased growth and higher prices as choice timber products. Such utilization for pulpwood makes possible this "cultivation with the ax," in contrast to wholesale slashing and clear cutting; and it is essential to good management of woodland, particularly on the farm.

Occasions arise when it is advisable to resort to planting forest trees, particularly on soils allocated in the land-use grouping to forest production. Shortleaf pine might well be used on the stony fine sandy loam types of the Muskingum, Hector, and Lehew series, on Apison very fine sandy loam, and on Talbott silty clay loam, hilly phase. Soils of the steep and eroded hilly phases of the Fullerton and Clarksville series, and Armuchee silt loam, are generally set to black locust, which should receive cultivation during the first growing season whenever possible, for satisfactory results. Commercial species, such as the oaks, yellow poplar, and black walnut, can be spot planted to advantage in more fertile sites among the locust, or they will come in naturally as the soil becomes stabilized and improved by this leguminous tree. Shortleaf pine should be encouraged throughout the county as a timber tree naturally adapted and having utility for both lumber and pulpwood.

On gullied and severely eroded soils, laborious preparation is generally needed prior to the actual planting of the seedling trees. Every particular situation presents a specific problem to be solved. The Civilian Conservation Corps camp at Kingston has been a pioneer in developing a simple technique within the capacity of the landowner and operator. Although dependence is still placed in mechanical structures of the check-dam type in the larger gullies, along with diversion ditches so located as to empty the normal accumulation of water into these improved permanent drains, the trend is toward simple methods requiring less labor. It is still good practice to use cedar-brush matting over a straw mulch, underneath which is seeded a suitable grass mixture. The ridges and sides of the smaller gullies are worked down to prevent continued loss of soil until locust, pine, and other vegetation has a chance to become established. In some places pine boughs are tied down with wood stakes and wire to retard the flow of water in small gullies and decrease its cutting action, and to facilitate stabilization of the soil and the growth of locust trees. Eroded areas of this kind must be fenced against livestock after treat-

ment and planting, in order to accomplish the control of water and erosion.

From 1933 through 1938, 48,000 locust, 14,000 shortleaf pine, 6,000 loblolly pine, and 1,000 yellow poplar seedlings were planted by 32 landowners under the direction of the county agricultural agent. The seedlings were produced by the State division of forestry and sold to the farmers at a nominal price. The total area planted was 69 acres. The Civilian Conservation Corps reforested 755 acres on 154 projects during the years 1936–38.[11]

Fire control is necessary not only for the satisfactory production of forest but also to maintain the water-absorbing capacity of the underlying soil. Repeated burning of the litter that normally accumulates under a forest cover and the accompanying baking of the soil can reduce the rate of absorption of water to about one-third [12] of what occurs where the forest is unburned. This rate of absorption remains more or less constant throughout the duration of extended rains in the unburned woods, whereas in the burned woods a marked reduction in the rate of absorption occurs. Furthermore, in some pastured woodland soils the rate may drop to as low as only one-twentieth of the rate of absorption in the undisturbed woods. Burning of the woods and intensive grazing of small areas by livestock not only destroy both young and old trees but lead to greater run-off of water, followed by loss of both water and soil and all the evils resulting therefrom.

Roane County is now included as a part of the North Cumberland District, organized for fire protection by the State division of forestry. The system of local district wardens, deputy wardens, and wardens is intended to support efforts of individual landowners in both prevention and suppression of forest fires. Every rural family would do well to learn the name of their nearest deputy forest warden with whom communication is possible in an emergency. The growing and management of timber, encouragement in the protection of fish and game, and even soil conservation in its many angles depend on the prevention of forest fires.

MORPHOLOGY AND GENESIS OF SOILS [13]

A soil is the product of five main factors, namely, climate, vegetation, parent material, relief, and age. Climate and vegetation are the active forces that attack the parent material and form or develop a soil. Relief is a conditioning factor that, in most places, largely controls natural drainage and therefore influences the effectiveness of climate and vegetation in their attack. If climate and vegetation have not had the opportunity to operate long enough to produce a soil that is in near equilibrium with its environment, the soil is considered young or immature, and it is in this regard that age manifests itself as an important factor. Some alluvial soils, for example, are considered to be very young, so young that climate

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[11] Records of the extension forester of the University of Tennessee and of the Forestry Relations Department of the Tennessee Valley Authority.

[12] AUTEN, JOHN T. POROSITY AND WATER ABSORPTION OF FOREST SOILS. U. S. Forest Service, Central States Forest Expt. Sta., Note 8, 4 pp., 1934. [Mimeographed]

——— THE EFFECT OF FOREST BURNING AND PASTURING IN THE OZARKS ON THE WATER ABSORPTION OF FOREST SOILS. U. S. Forest Service, Central States Forest Expt. Sta., Note 16, 5 pp., illus. 1934. [Mimeographed.]

[13] This section was prepared by A. C. Orvedal, Division of Soil Survey, Bureau of Plant Industry, U. S Department of Agriculture

and vegetation have not had time to produce any apparent effects in their attack.

Roane County lies in the northern part of the zone of the Red and Yellow Podzolic soils (*12*). In the mature soils, the color of the A horizon ranges from the brown of the Dewey soils to the very light gray or almost white of the Clarksville soils, and that of the subsoil from the red of the Dewey soils to the yellow of the Clarksville soils.

In table 4 (see p. 20), in the section on Soils, the color, consistence, and thickness of the A and B horizons and the parent material, the drainage, and the relief are tabulated for the soil series occurring in this county.

Except for the alluvial and colluvial materials, the parent materials are the residues of decomposition and leaching of consolidated sedimentary rocks—limestone, dolomites, shales, and sandstones. Geologically, these sedimentary rocks are old, having been formed during the Paleozoic era (*13*, *14*). The Knox dolomite formation underlies the Clarksville, Fullerton, and Dewey soils. The Chickamauga limestone formation underlies the Talbott, Upshur, Colbert, and Dewey soils, the high-grade limestone in this formation underlying the Dewey soils. The Conasauga shale formation underlies the Colbert and, to less extent, the Talbott soils. In Roane County this formation consists chiefly of highly argillaceous and somewhat shaly limestone with a few thin strata of shale, and not a pure shale, as the name might indicate. The Rome formation underlies all of the Apison and Lehew soils and some of the Muskingum and Hector soils. The Rockwood formation is the chief one underlying the Hector soils. The Walden sandstone formation underlies the Hartsells soils, the greater part of the Muskingum soils, and a small proportion of the Hector soils (*13*, *14*).

At the foot of the Cumberland escarpment and also at the foot of shale-sandstone ridges, sandy and stony colluvium and local alluvium underlie the Jefferson and Allen soils. Colluvium and local alluvium, derived chiefly from shaly slopes, underlie the Leadvale soils, and colluvium and local alluvium, at the foot of slopes of the Clarksville and Fullerton soils, underlie the Greendale soils. Among the streams are terraces and flood plains, on which the soil parent material consists of alluvial deposits that in many places contain some gravel, cobbles, and rounded sandstone.

Over the entire area of this county the climate is essentially the same, except on the Cumberland Plateau, where it is somewhat cooler. In other words, the climate is the same over the entire valley section, which embraces the Colbert, Talbott, Upshur, Dewey, Fullerton, Clarksville, Apison, Lehew, Hector, and Muskingum soils and all the soils of the colluvial lands, terraces, and bottom lands. Because of the fact that the climate is uniform over practically the entire area, local differences in these soils cannot be explained by climate. General characteristics common to all the well-developed, well-drained soils, however, such as the sequence in shades of color from the A horizon through the C horizon, are probably functions primarily of climate aided by vegetation.

The forces of climate alone cannot bring about the development of soils. Operating alone they can only produce the parent material from which the soils themselves can be developed. Without the

action of living organisms all soils would remain undeveloped and all would be azonal; they would be merely residual or transported products of rock weathering. Of the living organisms influencing soil development, plants and micro-organisms are of primary importance. The general type of vegetation is, to a large extent, controlled by climate, and in this way climate exerts a powerful indirect effect. A well-developed soil is the result of the concomitant attack of both climate and vegetation on the parent material. Where the variation in vegetation is significant, the general type of soil varies accordingly. In Roane County the same general type of vegetation, that is, chiefly deciduous forest, grew on all the well-developed, well-drained soils. Although differences in the density of the stands and in the relative proportion of each species were probable, the general oak-hickory-chestnut association prevailed over the entire county. Because no marked differences in vegetation were manifest on the well-developed, well-drained soils, the differences in the development of these soils cannot be accounted for by differences in vegetation.

By direct and indirect effects, climate tends to produce similar soils from different kinds of parent material; and, if it were not for the inhibiting factors of the parent material itself, of relief, of drainage, and in some places, of vegetation, the same kind of soil would prevail over the entire area. Although such a uniform soil obviously does not exist, some general descriptive statements apply to all the well-developed and well-drained soils of the general region. Under forest vegetation they all have dark A_1 horizons, and A_2 horizons that are lighter in color than either the A_1 or the B horizons; the B horizons generally are uniformly colored yellow, brown, or red and are heavier textured than the A_1 or the A_2 horizons; and the C horizons generally are heavy textured and light red mottled with yellow and olive.

According to some recent analyses, made by this bureau, of a number of soils of Jefferson County, Tenn., the silica content decreases and the alumina and iron oxide contents increase with depth. The content of organic matter is moderate in the A_1 horizon, less in the A_2 horizon, and very low in the B and C horizons. The soils are low in bases, particularly calcium and magnesium, and they are also low in phosphorus. In general, the ignition loss is relatively low, indicating that the combined water content is not high. The reaction is medium, strongly acid, or very strongly acid. In general, the amount of silt decreases, whereas the amount of clay increases with depth from the A_1 horizon through the C horizon; and the colloid content is low in the A horizon, much higher in the B horizon, but highest in the C horizon. The well-drained, well-developed soils in Roane County would be expected to be similar in these respects.

The preceding paragraphs have brought out the characteristics that all the well-developed, well-drained soils have in common, irrespective of parent material or relief. These characteristics, therefore, can be considered as those imposed by the forces of climate and vegetation and are characteristics that any well-developed soil under similar climatic and vegetative conditions will exhibit. They can there-

fore be considered zonal characteristics, and all soils that have them can be considered zonal soils.

Throughout the entire county a striking and consistent correlation exists between the soils and the kind of consolidated rock from which the soil parent material is residual. A less striking and less consistent correlation exists between the type of soil and the slope of the land. The present relief, however, is also mainly a function of the kind of consolidated rocks, which differ in rate of weathering and in content of insoluble minerals. Thus, not only the soils, but also the type of relief, are closely related to the type of consolidated rock.

The underlying rocks of this section are responsible for the character of the relief, which itself is an important factor in determining the local differences in soils. In other words, the consolidated rocks not only exert a powerful direct effect on the soils, but also a powerful indirect effect by determining to a large degree the character of the relief. To illustrate: Most of the extensive areas underlain by argillaceous and fairly high grade limestone are undulating to gently rolling; extensive areas underlain by highly siliceous limestones and dolomites generally are strongly rolling or hilly; and extensive areas underlain by sandstone and shale are, for the most part, hilly or steep. Therefore, by exerting both direct and indirect effects, the character of the consolidated rocks that give rise to the parent materials of these soils is the main factor in bringing about the development of different types of soils in this county.

In the humid section, soils occurring in broad depressions or on level or nearly level relief generally are poorly or imperfectly drained. In the limestone valley section, where the underlying rocks are limestone or dolomite, however, subterranean drainage is good and the general relationship of drainage conditions to relief does not exist on soils developed from residual parent material. This good subterranean drainage is probably due to the marked dip of the rock strata and to numerous subterranean caverns and crevices. Where the soils are underlain by limestones that have a marked dip, their internal drainage is apparently just as good on nearly level areas as on hilly areas. This excellent subterranean drainage on all slopes greatly reduces the influence of relief on the soils and allows the consolidated rocks to dominate completely the other factors in determining the local soil differences. In other words, the different responses of the different rocks to the forces of the same climate and vegetation are responsible for the different series of well-developed and well-drained soils in the county.

As the surface geology of this section consists of very old formations that were faulted and folded a long time ago, it is fairly safe to assume that the present relief is a product of natural geologic weathering and erosion. Supporting this assumption is the fact that ridge and mountain tops are capped with the most resistant rocks and the valley floors are underlain by the least resistant rocks (*2*). In keeping with this principle, most of the valleys of Roane County are underlain by the easily weathered argillaceous and shaly limestones and the more or less pure shales, and the ridges are underlain by either cherty dolomites, interbedded sandstone and shale, or chiefly

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sandstone. As the characteristics of the soils are closely related to the underlying rocks, their distribution is associated with the valleys and ridges. The Upshur, Colbert, and Talbott soils and rolling stony land (Colbert and Talbott soil materials) chiefly occupy the valleys, and the Clarksville and Fullerton soils mainly occupy the ridges. Likewise, the Apison soils are principally in the valleys, whereas the Lehew, Muskingum, and Hector soils, for the most part, are on ridges.

On the assumption that this whole section was a peneplain before the present relief was formed, it follows that the limestones underlying the Colbert and Talbott soils were the most soluble and most easily weathered of all the limestones and dolomites in this county. Because the present covering is thinner over the rock underlying these soils than it is over the rocks underlying the Dewey, Fullerton, and Clarksville soils, it is reasonable to assume that the limestones underlying the Upshur, Colbert, and Talbott soils had the lowest concentrations of insoluble material. Although the rock floor is uneven and rough, the average depth to bedrock probably increases, beginning with the Colbert soils, including the Talbott, Dewey, and Fullerton soils, and ending with the Clarksville soils. The conclusion from this is that the content of insoluble impurities of the underlying limestones and dolomites increased in the same sequence. The insoluble impurities are mainly silica, alumina, and ferric oxide.

Although some erosion of the surface soil has taken place, the differences in the depth to bedrock cannot be explained on that basis, except for the Apison, Lehew, Hector, and Muskingum soils. In the Upshur, Colbert, Talbott, Dewey, Fullerton, and Clarksville association, the depth to bedrock is more or less in direct opposition to what would be expected if differential natural erosion were responsible, when the predominating slopes of the respective series are taken into consideration. Considering the high rainfall, the streams in the limestone sections are comparatively scarce, and many of them sink into underground channels. Sinkholes everywhere dot the landscape, and much drainage water escapes through them. This condition indicates that the present relief in the limestone sections is caused mainly by differential dissolution and leaching of the underlying rocks, which has been going on for thousands of years; and, if this be true, the present covering over the rocks is the insoluble residue left after limestones and dolomites have been dissolved and leached out to a depth of hundreds of feet. The deepest covering would, therefore, be expected where the limestones and dolomites had the highest concentrations of insoluble impurities. As the covering became thicker and thicker, it served as an increasingly effective sponge in reducing the amount of water leaching through the underlying rocks; hence the increase in altitude with increase in content of insoluble impurities. Therefore, the Colbert, Talbott, and Upshur soils are the shallowest to bedrock and at the same time occupy the lowest positions in the valley, whereas the Clarksville are the deepest to bedrock and generally occupy the highest positions, with the Dewey and Fullerton soils between these two extremes.

In Roane County the limestones and dolomites give rise to parent materials that in turn give rise to six soil series; namely, Upshur, Colbert, Talbott, Dewey, Fullerton, and Clarksville. The Upshur,

Colbert, and Talbott soils come from argillaceous and shaly limestones, whereas the Dewey, Fullerton, and Clarksville come from siliceous (cherty) dolomites and limestones. The limestones giving rise to the parent materials for these soils differ among themselves. The limestone underlying the Upshur soils is highly argillaceous and shaly and is conspicuous because of its purple color. The limestones underlying the Colbert and Talbott soils are chiefly gray, but the rock under the Colbert soils is high in argillaceous material, and the rock underlying the Talbott soils is moderate to low in argillaceous material. The rocks under the Colbert and Talbott soils generally contain thin seams of shale or clay, most of them less than one-eighth of an inch thick. These seams are more numerous in the rock under the Colbert soils than in that under the Talbott soils. The parent material for the Dewey, Fullerton, and Clarksville soils comes chiefly from magnesian limestones, that is, dolomites. All these rocks are low in argillaceous material, but they contain different amounts of silica, chiefly in the form of chert. The rock under the Dewey soils generally contains only a small amount of chert, that under the Fullerton soils a moderate to relatively high amount, and that under the Clarksville soils a very high amount.

As has been stated, the Dewey soils come chiefly from magnesian limestone that is generally considered high grade; that is, high in carbonates and low in clay and silica. The content of insoluble impurities, however, particularly silica, is greater than in the rocks underlying the Upshur, Colbert, and Talbott soils, but less than in the rocks underlying the Fullerton and Clarksville soils. The soils of the Dewey series are zonal soils, having fairly well defined A, B, and C horizons. The B horizon, however, apparently does not contain a greater proportion of clay than the C horizon. The Dewey soils have developed under a forest vegetation, chiefly deciduous. As these soils are productive of crops, it is reasonable to assume that they also supported a luxuriant forest with considerable undergrowth before they were cleared, and this partly accounts for the brown color of the A horizon. Over their area of occurrence, the dominant relief of the Dewey soils is undulating and gently rolling. In Roane County, however, much of the relief is hilly and some is steep. In the great valley of east Tennessee these soils commonly occur in discontinuous belts between the Talbott and Colbert soils on the lower side and the Fullerton and Clarksville soils on the upper side. In Roane County, however, this manner of occurrence is not so common. A few areas with soils classified as Dewey lie on top of some of the cherty ridges. The great proportion of the total area occupied by the Dewey soils in Roane County is eroded, and these soils now have truncated profiles. The following description of a profile is typical of uneroded Dewey soils.

A_1. 0 to 3 inches, dark-brown soft and mellow silt loam, which crumbles readily into soft granules. It is high in organic matter and contains a few small chert fragments.

A_2. 3 to 12 inches, light-brown friable mellow and soft silt loam, with a good distribution of roots and a few small chert fragments.

A_3 or B_1. 12 to 18 inches, light reddish-brown friable heavy silt loam, which breaks readily into small soft granules that are easily crushed to a smooth mass. The material is moderately sticky when wet and contains a few chert fragments.

B_2. 18 to 40 inches, brownish-red silty clay loam, fairly friable, but slightly brittle, and breaking into irregular-sized subangular aggregates that are fairly easily crushed to a smooth yellowish-red mass. The aggregates are glossy on the surface. The material is only slightly plastic when wet. Numerous small black round concretions and chert fragments are present.

B_3. 40 to 60 inches, bright-red fairly stiff and tight silty clay containing here and there a mingling of yellow. The material is difficult to dislodge, but when displaced it breaks readily into angular and subangular aggregates of various sizes, which with moderate pressure, can be crushed to a reddish-yellow smooth moderately plastic and sticky mass. Chert fragments are common.

C. 60 to 72 inches, heavy stiff plastic and sticky clay, reddish yellow, highly mottled with red, yellow, and olive. Like the material in the layer above, the displaced material breaks into more or less angular aggregates.

Like the Dewey soils, the Fullerton soils are zonal. The Fullerton soils are derived from material residual from dolomites high in impurities, particularly silica. The silica occurs chiefly in the form of chert. The relief on which most of the Fullerton soils occur is typically rolling and hilly, characterized by ridges or dome-shaped hills. Judging by the abundance of dead chestnut trees and the common local names of "Chestnut Ridge" where the Fullerton soils and Clarksville soils occur, it is reasonable to suppose that chestnut trees originally were numerous on these soils. The Fullerton soils, particularly where they contain considerable chert, are not nearly so susceptible to erosion as the Dewey and Talbott soils on corresponding slopes. Following is a description of a typical profile of Fullerton cherty silt loam:

A_1. 0 to 2 inches, dark-gray silt loam stained dark with organic matter. Roots and chert fragments are numerous.

A_2. 2 to 10 inches, brownish-gray soft mellow and friable silt loam containing a few chert fragments.

A_3. 10 to 15 inches, pale-yellow very friable heavy silt loam, containing a few chert fragments.

B_2. 15 to 40 inches, yellowish-red or salmon-colored silty clay loam, with a few minglings or mottlings of ocher yellow. Although the material is friable, it is slightly brittle and hard in place. Displaced pieces easily break into irregular-sized and irregular-shaped aggregates that crush under moderate pressure to a slightly gritty mass. When wet the material is moderately sticky and plastic. It generally contains numerous chert fragments, some of which are large.

C_1. 40 to 70 inches, tight plastic and sticky clay, reddish yellow mottled with some ocher yellow, olive, gray, and red. The material has a more angular structure than that in the layer above.

C. 70 to 84 inches +, tight tough plastic and sticky clay, reddish yellow and highly mottled with ocher yellow, gray, olive, and red.

Like the Talbott, Dewey, and Fullerton soils, the Clarksville soils are zonal. They are closely associated with the Fullerton soils, but the Clarksville soils come from dolomite that has a higher content of chert; they contain more chert in the soil mass, and the A and B horizons are considerably lighter colored. The Clarksville soils also have developed under a forest vegetation that was chiefly deciduous. The typical relief is hilly, but it ranges from rolling to steep. The following description is representative of a profile of the Clarksville soils:

A_1. 0 to 1½ inches, gray loose cherty silt loam stained dark with organic matter.

A_2. 1½ to 10 inches, pale yellowish-gray loose friable silt loam containing considerable gritty material and chert fragments.

B_2. 10 to 24 inches, pale brownish-yellow silty clay loam, friable but with a suggestion of brittleness. It breaks readily into successively smaller particles until a uniform slightly gritty mass is formed. It contains numerous chert fragments and a few tiny black concretions.

B_3. 24 to 28 inches, a gradational layer of fairly friable but slightly brittle silty clay loam. The color is a mingling of ocher yellow, brownish yellow, and brownish red. Chert fragments are numerous. The material crushes to a light reddish-yellow mass. It breaks readily into angular and subangular granules, some of which are red on the outside and yellow on the inside. These are firm.

C_1. 28 to 50 inches, silty clay loam. The color is a mingling of light red, yellow, brownish yellow, and olive. Chert fragments are numerous. The material is hard in place and suggestive of an incipient hardpan. Displaced pieces are rather brittle, although moderately friable.

C. 50 to 70 inches, rather stiff tight sticky and plastic clay containing rather large chert fragments. The main color is light reddish yellow, but mottlings of red, yellow, olive, and gray are numerous.

The Talbott soils are zonal, having fairly well defined A, B, and C horizons. As previously stated, they have developed from material that is residual from the weathering of argillaceous limestone, and this limestone differs from that under the Colbert soils in containing less argillaceous material. The Talbott soils have developed under a forest vegetation, chiefly deciduous, on relief that is typically rolling but ranges from undulating to hilly. In contrast to the Dewey, Fullerton, and Clarksville soils, the Talbott soils are relatively shallow over bedrock. As the rock floor is uneven and jagged, the depth to bedrock is variable, but generally it is only a few feet. Rock outcrops are common. As a result of this variable depth to bedrock, the thickness of the B and C horizons is variable. Partly because of the heavy consistence of the B and C horizons, the Talbott soils are very susceptible to accelerated erosion, even on mild slopes; and, after being cleared of the forest cover, much of the soil has been eroded so that in many areas the present profile is truncated and practically devoid of an A horizon. The following description is of a profile typical of Talbott soils still in woods:

A_1. 0 to 2 inches, grayish-brown friable mellow silty clay loam, slightly stained with organic matter.

A_2. 2 to 7 inches, pale yellowish-brown heavy silt loam. The color is not uniform but is a mingling of light shades of yellow, reddish brown, and gray. The material readily falls apart into soft crumbs of various sizes and shapes. The darker colored aggregates are firmer than the light-colored ones. Roots are numerous.

B_2. 7 to 24 inches, tight, tough, plastic, sticky silty clay, yellowish red with some minglings of olive, ocher yellow, and red. The material is difficult to dislodge and breaks into angular aggregates of various sizes, many of which are firm. These are red on the outside and yellow or olive on the inside and have shiny or glossy surfaces. Fine roots are scarce, but large roots are fairly numerous.

C_1. 24 to 42 inches, heavy silty clay similar to that in the layer above but more highly variegated with olive, yellow, red, and brown. The crushed material is reddish yellow. The material in this layer differs from the overlying material in that it is not quite so tough and has a slight suggestion of brittleness. Although dislodged with difficulty, the displaced pieces break readily into angular aggregates with glossy surfaces.

C. 42 to 72 inches, yellowish red, very plastic clay highly mottled with reddish brown, rust brown, yellow, gray, and olive. The material contains a few chert and limestone fragments. This continues down to the bedrock, which in this place lies at a depth of 72 inches and consists of slightly argillaceous limestone.

The Colbert soils have developed from material that is residual from the weathering of highly argillaceous limestones, these rocks generally having thin layers of shale distributed throughout the limestone. On the geologic maps these rocks are included with the Chickamauga limestone and Conasauga shale (*13*, *14*). Where these limestones are exposed to air, they are soft and chalklike on the surface and have a gray color that is frequently described as "muddy." Forest, chiefly of deciduous trees, makes up the native vegetation. The typical relief is undulating. The extremely heavy character of the parent material has retarded the development of the Colbert soils. The A horizon, which in most places is only about 5 inches thick, consists of brownish-gray or olive-gray silty clay loam. The B horizon consists of tight, tough, tenacious, sticky plastic clay or silty clay, mainly olive yellow, mottled with gray, green, yellow, red, and brown. As the boundary between the B and C horizons is very indistinct, the thickness of the B horizon is not very definite, but it averages about 15 inches. The C horizon is similar to the B horizon, except that it contains more blue, green, and gray mottlings. It varies in thickness, depending on the depth to bedrock, which generally ranges from 2 to 4 feet. Bedrock outcrops are common in areas of these soils. Although the Colbert soils may be considered zonal soils, they barely fall within the range of zonal soils. Some soil scientists may prefer to consider them azonal soils.

Soils of the Upshur series in this county have developed from parent material that is residuum from the weathering of purplish-red or reddish-purple shaly and highly argillaceous limestones. On the geologic map these rocks are included in the Chickamauga limestone formation (*14*). The vegetation was chiefly deciduous forest that presumably contained considerable grass. The dominant relief is rolling. These soils are unusual for this general section in two respects; one is the purple color, and the other is the neutral or slightly alkaline reaction. Only a valley phase of the silty clay loam type is mapped in this county. This soil has a purplish-brown A horizon about 4 inches thick, consisting of friable silty clay loam. The B horizon is about 20 inches thick and consists of tough and plastic purplish-red clay or silty clay. In most places the C horizon is absent and the B horizon rests directly on the partly weathered shaly limestone. It is evident that the purple color in this soil is inherited from the parent material. This is a Rendzina soil.

The Armuchee soils are azonal. Soils developed from closely interbedded limestone and shale are classified as members of this series. These soils are shallow over bedrock, excessively drained, and acid in reaction. The typical relief is hilly or very strongly sloping. In profile features these soils are, of course, variable. They range from about 6 to 15 inches in thickness over the shale. In places where a weak profile has developed, the A horizon is 2 or 3 inches thick and consists of light-gray or yellowish-gray silt loam or silty clay loam, and the B horizon ranges in thickness from about 6 to 12 inches and consists of yellowish-brown or brownish-yellow moderately friable silty clay loam or silty clay. In most places shale fragments are numerous throughout the soil mass. In places where the proportion of limestone in the parent rock is greater than is typical, the soil is

deeper and has a red cast in the B horizon. Shales, it will be recalled, resist chemical weathering but not mechanical weathering; that is, they are highly resistant to dissolution by water, but they are readily subject to removal by running water. As these soils have a pronounced relief, run-off is rapid. On these steep slopes, natural or geological erosion has kept pace with the formation of parent material; consequently, the parent material has not lain in place long enough for the dynamic forces of soil formation to produce a well-developed soil profile.

The Apison soils have developed from material that is residual from the weathering of acid shale, with a small admixture of sandstone, which geologically comprises the less sandy part of the Rome formation (*13*, *14*). They have developed under a forest vegetation, presumably a mixture of hardwoods and conifers. They have undulating to rolling relief. The typical Apison soils are zonal. In Roane County, however, most areas of these soils have been cleared, and subsequent to clearing they have become so badly eroded that they are now essentially azonal soils—Lithosols. In the uneroded condition, these soils are only 2 to 3 feet thick over the shale bedrock. In uneroded areas these soils have a brownish-gray or yellowish-gray A horizon about 7 inches thick. This material is loose and open. The B horizon is about 14 inches thick and consists of brownish-yellow friable very fine sandy clay. A few yellow, gray, red, brown, and purple splotches are present in the lower part of the B horizon. The C horizon consists of very fine sandy clay material that contains numerous decomposing shale fragments and a few sandstone fragments. The color is chiefly brownish yellow splotched with yellow, gray, purple, red, and brown. Most of the splotches in the lower part of the B horizon and throughout the C horizon result from the recent decomposition of shale fragments of various colors, not from poor internal drainage. The C horizon rests on the varicolored shale—yellow, grayish yellow, purplish yellow, yellowish purple, grayish purple, and purplish red. Some of this shale is sandy, and a few thin sandstone strata are widely spaced throughout the shale.

The soils of the Lehew, Muskingum, and Hector series are azonal—Lithosols. All these soils are stony, have hilly to steep relief, are shallow over bedrock, and have come from sandstone or sandstone interbedded with acid shale. These soils differ chiefly in color, which, to a large extent, is inherited from the parent rocks. The Lehew soils have purplish-gray surface soils and purplish-yellow or purplish-brown subsoils; the Muskingum soils have grayish-yellow surface soils and brownish-yellow subsoils; and the Hector soils have grayish-brown surface soils and reddish-brown subsoils. In Roane County the Lehew soils are confined to the Rome formation, the Hector soils are mapped chiefly on the Rockwood formation, and the Muskingum soils chiefly on the Walden sandstone formation but also on the Rome and Rockwood formations (*13*, *14*). The great proportion of the total area occupied by these soils is still in forest, which consists of a mixture of deciduous and coniferous trees, with the deciduous trees dominant. Owing to the hilly to steep relief, which has facilitated geologic erosion of the soil material, and to the

resistant character of the parent rocks to weathering, the parent material of these soils has not lain in place long enough for well-developed profiles to have formed.

The soils of the Hartsells series have developed from material that is residual from the weathering of horizontally bedded sandstone with a small admixture of shale. Geologically, these rocks are classified in the Walden sandstone formation (*13*). Although these soils do not show much development, they show enough to be definitely considered zonal soils; but there may be some doubt as to whether they belong to the Yellow Podzolic group or the Gray-Brown Podzolic group. These soils, it will be recalled, have developed in a cooler climate than the well-developed, well-drained soils of the great valley section of the county. The Hartsells soils are rather shallow over bedrock, ranging from 3 to 4 feet in most places. These soils are well drained. They have developed under a deciduous forest consisting chiefly of oaks. Their relief is undulating to gently rolling. The 1- or 2-inch A_1 horizon consists of gray loose very fine sandy loam stained dark with organic matter. The A_2 horizon is about 7 inches thick and consists of loose yellowish-gray or brownish-gray very fine sandy loam. The B horizon is about 20 inches thick and consists of yellow, brownish-yellow, or reddish-yellow friable and crumbly very fine sandy clay or clay loam. A few red and brown mottlings are generally present in the lower part of this layer, but these are apparently due to decomposing sandstone fragments rather than to poor drainage. The C horizon is variable, but in the main it consists of sandy material that contains numerous sandstone fragments and is mottled with yellow, red, gray, and brown. In most places the thickness of the C horizon ranges from 1 to 12 inches and in a few places is more than 15 inches. The C horizon rests on the horizontally bedded light-colored sandstone with a small admixture of shale.

As explained in the section on Soils, the term "colluvial lands" in this report refers to those accumulations at the foot of slopes, particularly the longer and steeper slopes, where geologic erosion has been active. The material is actually a combination of colluvium and local alluvium. Many of the areas are alluvial fans or cones at mouths of very short drains. The soils on these so-called colluvial lands are classified in four series, namely, Allen, Jefferson, Leadvale, and Greendale. Although the soils in none of these series can be considered old or fully mature, in a great many areas they show considerable development and manifest color profiles of zonal soils. They range in degree of profile development from practically none, where the accumulations are of very recent deposition, to fairly well developed, where the accumulations have lain in place for considerable time.

The material giving rise to the Allen soils comes chiefly from sandstone escarpments and soils such as the Hector, Muskingum, and Lehew. The Allen soils generally are fairly well developed, having a grayish-brown friable very fine sandy loam A horizon about 8 inches thick and a brownish-red friable very fine sandy clay B horizon about 25 inches thick. Some sandstones are present in most areas of these soils. It is possible that some of the red color is in-

herited from the parent material, particularly in those areas at the foot of slopes of Bacon, Welcer, and Riley Ridges. It is more probable, however, that the red color in most areas is the result of soil development. The soils on these colluvial positions are chiefly yellow—members of the Jefferson series—except where there is the possibility of slight influence from limestones or other calcareous rocks, and here the soils are red—members of the Allen series.

The material giving rise to the Jefferson soils also comes from sandstone escarpments and soils such as the Muskingum, Lehew, and Hector. The Jefferson soils are generally stony and somewhat variable in character, particularly in degree of profile development. Where the soils of this series are fairly well developed they have a grayish-yellow loose gravelly fine sandy loam A horizon about 9 inches thick and a brownish-yellow friable fine sandy clay B horizon about 20 inches thick.

The material giving rise to the Leadvale soils has been washed chiefly from the Apison soils and the shales that normally underlie the Apison soils. The Leadvale soils resemble the Jefferson soils in color and, like the Jefferson soils, are variable in degree of profile development. Where they are fairly well developed, the Leadvale soils have a brownish-gray loose very fine sandy loam A horizon about 10 inches thick and a firm but friable yellow silty clay loam B horizon about 15 inches thick.

The material giving rise to the Greendale soils has washed chiefly from the Clarksville and Fullerton soils. The Greendale soils resemble the Leadvale and Jefferson soils in color and, like them, are also variable in degree of profile development. Where they are fairly well developed they have a grayish-brown loose silt loam A horizon about 8 inches thick and a yellow friable silty clay loam B horizon about 18 inches thick.

The soils on the stream terraces are classified in four series, namely, the Nolichucky, Waynesboro, Sequatchie, and Wolftever. The Nolichucky, Waynesboro, and Sequatchie soils are developed from alluvium most of which probably has come from uplands underlain by sandstone and shale; whereas the Wolftever soils have come from alluvium most of which probably has come from uplands underlain by limestone. The soils of all four series have developed under a forest cover consisting chiefly of deciduous trees.

The Nolichucky and Waynesboro soils are developed on the older higher terraces. They are zonal soils with well-developed profiles. Genetically, the Waynesboro soils are probably somewhat younger and are less leached than the Nolichucky soils. The relief of the soils of both series is undulating and gently rolling. The Nolichucky soils have a yellowish-gray loose very fine sandy loam A horizon about 10 inches thick and a yellowish-red firm but friable very fine sandy clay B horizon about 24 inches thick. The Waynesboro soils have a light-brown loose very fine sandy loam A horizon about 8 inches thick and a yellowish-red firm but friable very fine sandy clay B horizon about 26 inches thick.

The Sequatchie soils occur on the younger lower terraces and show but little development of a profile. They are level or nearly level. The A horizon is about 10 inches thick and consists of light-

brown loose very fine sandy loam. The B horizon is about 25 inches thick and consists of yellowish-brown very friable very fine sandy clay loam.

The Wolftever soils also occur on the younger lower terraces, some of them being so low that they are flooded during extremely high floods. As previously stated, the alluvium giving rise to these soils is derived chiefly from those uplands that are underlain by limestone. The Wolftever soils show considerable profile development, a conspicuous feature of the profile being the compact layer at a depth of 2 feet below the surface. They can therefore be considered as belonging to the intrazonal group of Planosols. The Wolftever soils have a nearly level to gently undulating relief. External drainage is generally fair, and internal drainage in most places is adequate for most of the common crops but is retarded somewhat by the compact layer. The A horizon is about 10 inches thick and consists of light-brown mellow silt loam. The B horizon is about 14 inches thick and consists of yellowish-brown moderately compact but fairly friable silty clay loam. The B horizon rests on a rather conspicuous compact layer ranging in thickness from about 1 to 2 feet and consisting of brownish-yellow compact and tight silty clay loam highly mottled with gray, yellow, and brown.

The soils in the bottom lands, or flood plains, are classified in seven series, namely, Huntington, Lindside, Melvin, Pope, Philo, Atkins, and Roane. All these soils are young and have undergone very little development. They are subject to flooding and receive small deposits of alluvial material every time they are flooded. These soils are azonal—alluvial soils.

The Huntington, Lindside, and Melvin soils constitute a catena on alluvial material most of which has come from uplands underlain by limestone. These soils are neutral or slightly acid in reaction. They are chiefly silt loams. The Huntington soils are well drained, the Lindside soils intermediately drained, and the Melvin soils poorly drained. The Huntington soils are rich brown to a depth of more than 30 inches; the Lindside soils are brown to a depth ranging from 12 to 18 inches, below which they are highly mottled; and the Melvin soils are mottled from the surface downward.

The Pope, Philo, and Atkins soils constitute a catena on alluvial material most of which has come from uplands underlain by sandstone and shale. These soils are strongly to very strongly acid in reaction. They are chiefly very fine sandy loams. The Pope soils are well drained, the Philo soils intermediately drained, and the Atkins soils poorly drained. The Pope soils are light brown to a depth of more than 30 inches; the Philo soils are light brown to a depth ranging from 12 to 20 inches, below which they are highly mottled; and the Atkins soils are mottled from the surface downward. In drainage the Pope soils are comparable to the Huntington soils, the Philo soils to the Lindside soils, and the Atkins soils to the Melvin soils.

The Roane soils are rather unusual in that they have a tightly bedded layer of chert at a depth ranging from 15 to 30 inches below the surface. The alluvial material giving rise to these soils comes chiefly from the Clarksville and Fullerton soils of the upland—soils that contain large quantities of chert. The Roane soils occupy the

narrow bottom-land strips along small streams flowing out of areas of Clarksville and Fullerton soils. Roane gravelly loam to a depth ranging from 15 to 30 inches is grayish-brown loose and open cherty loam. This material rests on a bed of chert, in which the fragments are tightly embedded, and it is somewhat cemented, particularly in the upper part. The thickness of the bed of chert is variable, but in most places it exceeds 1 foot. The soil material of this layer is mottled with brown, gray, and yellow. Very few roots are in this layer. In some places two discernible soil layers have developed over the bed of chert. The topmost layer is grayish-brown cherty silt loam to a depth of about 10 inches, below which the material extending down to the bed of chert is yellowish-brown heavy silt loam or silty clay loam. This soil is fairly well drained, as the somewhat cemented cherty layer does not interfere materially with the percolation of water.

SUMMARY

Roane County is in the central part of eastern Tennessee. The total land area is 380 square miles, or 243,200 acres.

The county forms a part of two important physiographic units—the Cumberland Plateau and the great valley of east Tennessee. The general elevation of the plateau part of the county is about 1,500 feet above sea level, and that of the great valley part is about 700 to 900 feet. The relief ranges from undulating to semimountainous.

The climate is temperate and continental. Its salient features are moderate winters characterized by short, erratic cold spells; mild summers with pleasant evenings; and a well-distributed mean annual precipitation. In the valley section the annual precipitation averages about 51 inches and the frost-free period about 196 days.

The first permanent white settlements were made nearly 150 years ago, and agriculture has been the principal pursuit ever since. The agriculture has developed from typical pioneer farming to the present widely diversified farming. The crops consist of corn, lespedeza and other legumes, grasses, wheat and other small grains, tobacco, beans, potatoes, sweetpotatoes, and a number of less important truck crops. Peach growing is important. Apples, pears, plums, cherries, grapes, and strawberries are less important fruits. The total value of important agricultural products was reported by the 1930 census as $1,598,117. The production of crops is combined with the raising of livestock in most sections. The change of agriculture from the simple to the complex is a natural one toward the adjustment of agriculture to even more diverse soil and land conditions.

The soils of this county differ widely in characteristics and conditions associated with productivity and use capabilities. Some of these are texture, consistence, fertility, reaction, color, and conditions of erosion, stoniness, and moisture. Largely on such differences, the soils are classified and mapped in 27 soil series, which are, in turn, separated into a large number of soil types, soil phases, and miscellaneous land types. Topographically, these soils may be placed in the following four groups: (1) Soils of the uplands—the largest group, of which the Clarksville, Fullerton, and Muskingum are the

most extensive soils; (2) soils of the colluvial lands—a small group, of which the Allen soils are most extensive; (3) soils of the terraces—a small group, of which the Waynesboro soils are the most extensive; and (4) soils of the bottom lands, of which the Pope soils are the most extensive. In the section on Soils, each soil is described and its relationship to agriculture is discussed.

In the section on Productivity Ratings and Land Classification the productivity rating of each soil for various crops is tabulated and the soils are grouped in five classes on the basis of their productivity, workability, and problems of conservation. The First-class soils cover 4,736 acres, or about 2 percent of the county; Second-class soils, 24,128 acres, or 10 percent; Third-class soils, 56,000 acres, or 23 percent; Fourth-class soils, 49,600 acres, or 20 percent; and Fifth-class soils, 108,736 acres, or 45 percent. Generally speaking, First-, Second-, and Third-class soils are physically adapted to use for crops; Fourth-class soils are not considered suitable for crops but can be used for pasture; and Fifth-class soils are unsuitable for both crops and pasture but are suitable to forest.

Failure to adjust the use of the land to the character of the soils is indicated by low yields, poor pasture, and erosion. The choice of crops and an adequate system of rotation, the application of needed amendments, and the return to pasture and forest of land unsuited to crops are essential to proper management.

Of the several measures to control water on the land, control or run-off is by far the most important problem in this county. This is achieved primarily by adjusting land use and secondarily by mechanical means. Artificial drainage is needed only on a small area.

Originally the entire county was forested. All the virgin timber has been cut, and about 60 percent of the area is now in second-growth forest. Thinning, an essential practice in good forest management, utilizes the smaller and less desirable trees as pulpwood and reserves the finer trees for timber.

Roane County lies in the northern part of the Red and Yellow Podzolic soils region. The soils bear a close correlation to the underlying geologic formations from which their parent materials are derived. These formations include Knox dolomite underlying the Clarksville, Fullerton, and Dewey soils; Chickamauga limestone underlying the Talbott, Upshur, Colbert, and Dewey soils; Conasauga shale underlying the Colbert and, to less extent, the Talbott soils; the Rome formation underlying the Apison and Lehew soils and some of the Muskingum and Hector soils; and Walden sandstone underlying all the Hartsells, most of the Muskingum, and part of the Hector soils. Colluvium and local alluvium underlie the soils of the colluvial lands, and alluvial deposits make up the parent material of the soils of the bottom lands. The morphology and genesis of soils are discussed from the point of view of the soil scientist, particularly in connection with soil classification. The aim of this section is to meet the needs of the soil student or soil scientist rather than those of the layman.

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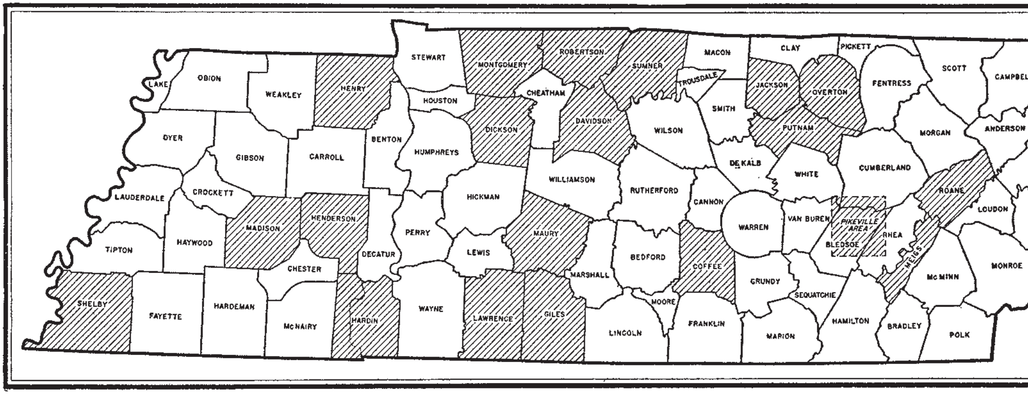

Areas surveyed in Tennessee, shown by shading.

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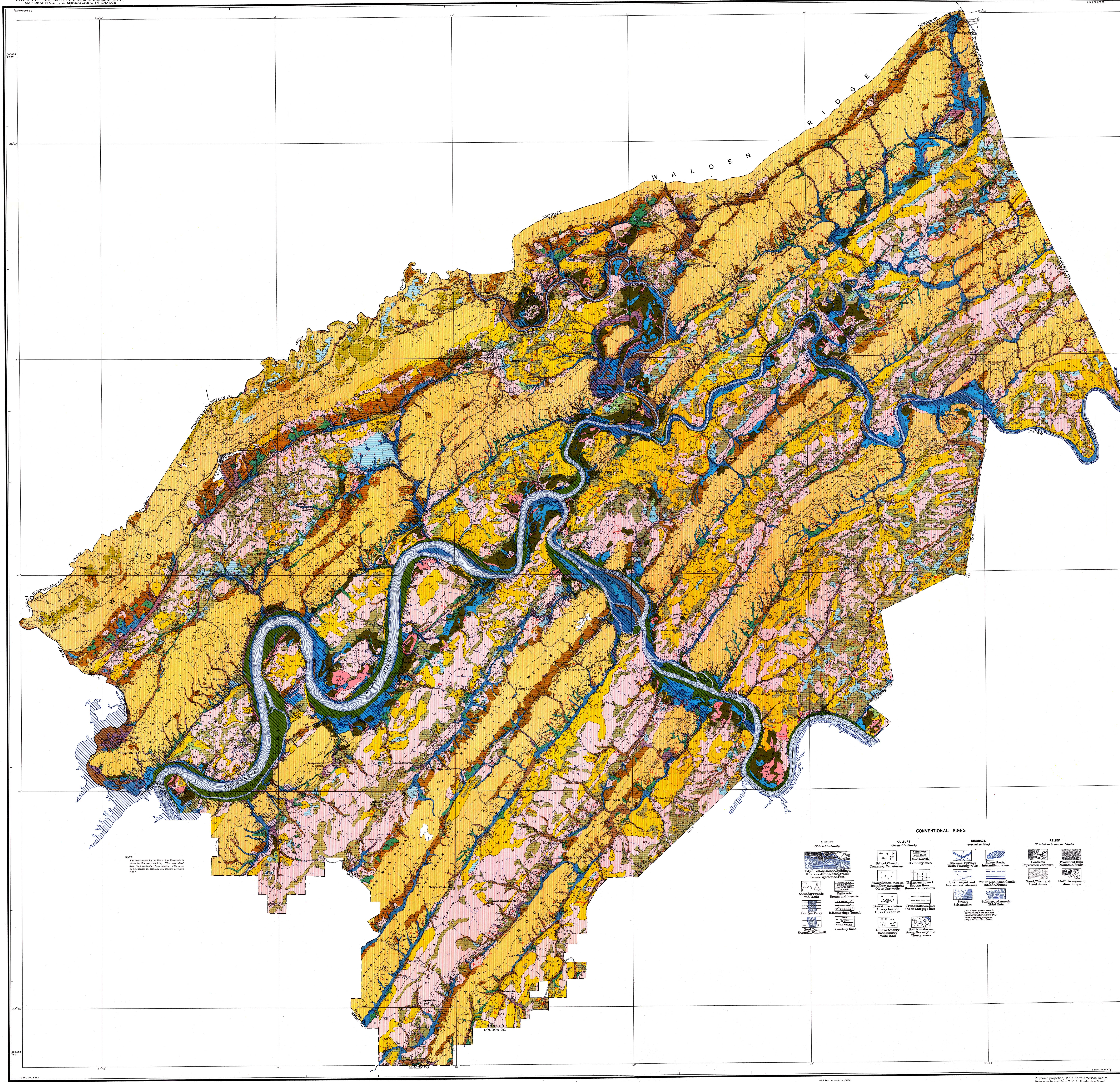
MAP DRAFTING, J. W. McKERICHER, IN CHARGE

SOIL MAP
ROANE COUNTY
TENNESSEE

TENNESSEE AGRICULTURAL EXPERIMENT STATI[ON]
C. A. MOOERS, DIRECTOR
TENNESSEE VALLEY AUTHORITY



J. W. Moon, Inspector, District 2.
Soils surveyed by M. E. Swann, in charge, and Wallace Roberts, E. H. Hubbard, and H. C. Porter, Tennessee Agricultural Experiment Station.

Scale $\frac{1}{48,000}$
1 ½ 0 1 2 3 Miles
5,000 0 5,000 10,000 Feet

LITHO EASTERN OFFSET INC., BALTO.

Polyconic projection, 1927 North American Datum.
Base map in part from T. V. A. Planimetric Maps.
10000 foot grid based upon Tennessee system of plane coo[rdinates]
Surveyed in 1935-36. Series 1936.